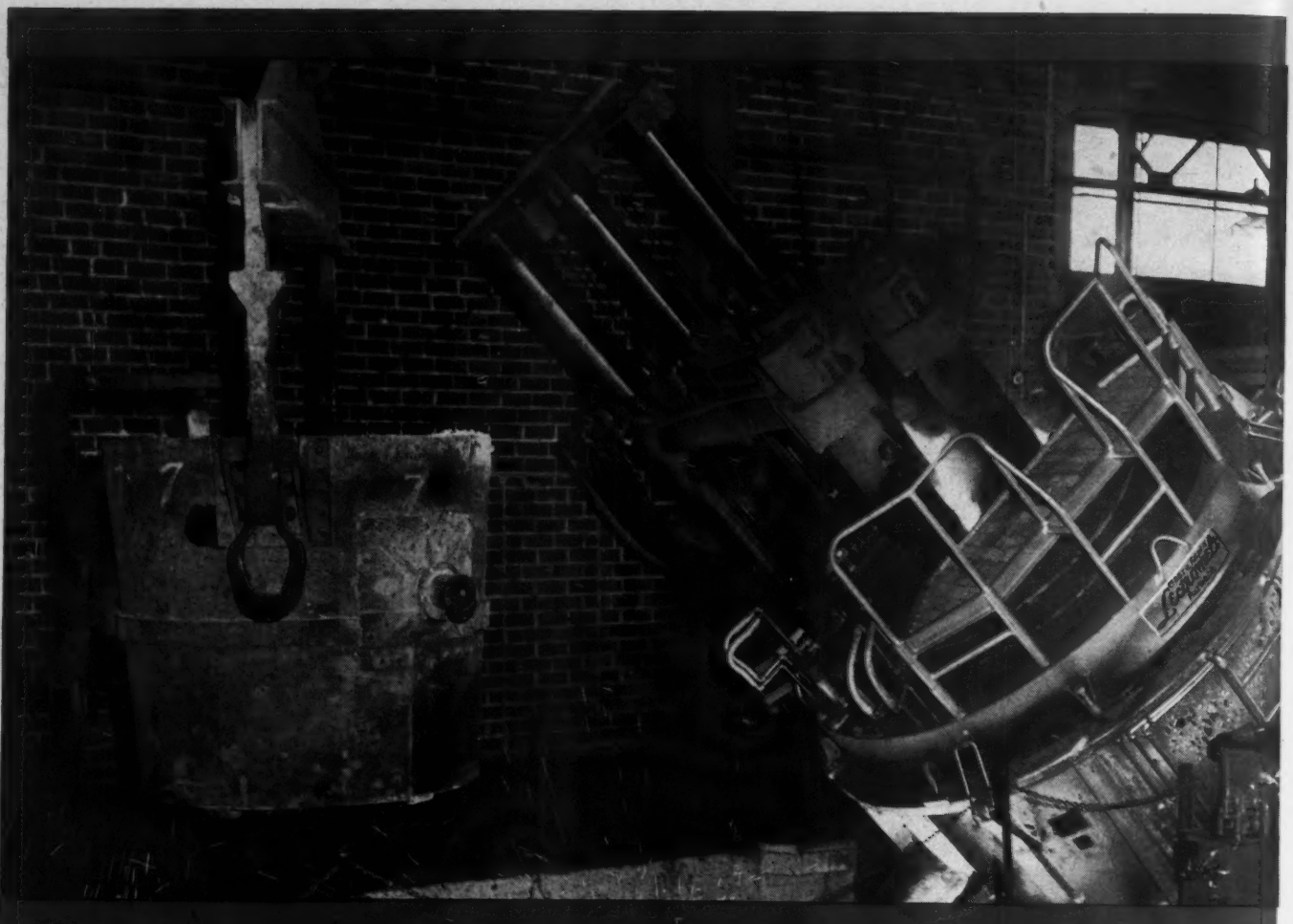
American Foundryman

MARCH 1946

★ THE FOUNDRYMEN'S OWN MAGAZINE



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★ MARCH WHO'S WHO ★

Vincent J. Sedlon

In *"Pattern Analysis for Buyers of Patterns and Castings,"* Mr. Sedlon presents recommendations springing from an association with the pattern industry for the past thirty years . . . Born in Philadelphia, he received his early schooling in Cleveland . . . Became associated with Master Pattern Company, of the same city, in 1930 as president . . . A member of A.F.A., Mr. Sedlon is co-author, with F. C. Cech, of *"Coating for Wood Patterns,"* presented before the 1940 A.F.A. Convention and published in TRANSACTIONS the same year.

Pierce Boutin

Mr. Boutin, whose article on *"Eliminating Casting Defects"* appears in this issue, is night superintendent with Pontiac Motor Co., General Motors Corp., Pontiac, Mich. . . . Born in Merrill, Mich., in 1906 . . . Received A.B. degree at Alma College, Alma, Mich., 1928 . . . After five years as high school instructor in science subjects, entered Saginaw plant of Chevrolet Gray Iron Div., 1933 . . . Transferring to Pontiac foundry three years later.

Julius A. Griffin

Author of *"Gray Iron Castings Welding and Salvage,"* presented in this issue, Mr. Griffin is a native of Murphysboro, Ill., where he received his early schooling . . . Entered the casting industry as a foundry worker with Harrison Iron Works, Murphysboro, in 1918 . . . Moved to Detroit where he became associated with Motor Products . . . Later with Graham Paige Motor Corp., in the capacity of inspector . . . In 1933 advanced to the position of assistant foundry engineer with the same firm . . . Joined Pontiac Motor Co., Pontiac, Mich., in 1937, as supervisor of welding and salvage, his present position . . . Member of A.F.A., Mr. Griffin assisted in the writing of welding procedures accepted by the War Engineering board.

William C. Wick

Native of Chicago, Mr. Wick served his apprenticeship in the industry with Whiting Corp., Harvey, Ill. . . . Joined Armour Research Foundation, Chicago, in 1940 as cupola operator . . .Entered U. S. Navy in 1943 . . . Was associated with Naval Research Laboratory, Washington, D. C., from 1944 until his discharge in 1946 . . . Rejoined Armour Research Foundation as assistant metallurgist, his present position . . . Member of A.F.A. . . . Co-author, with H. F. Taylor, of *"Insulating Pads and Riser Sleeves for Bronze Castings,"* in this issue.

Howard F. Taylor

Co-author, with W. C. Wick, of *"Insulating Pads and Riser Sleeves for Bronze Castings"* . . . Born in Leslie, Mich. . . . Received Bachelor of Science and Master of Science degrees from Michigan State College, East Lansing . . . At present is on leave from the Naval Research Laboratory, Washington, D. C., studying for his Doctor's degree at Massachusetts Institute of Technology, Cambridge, Mass., as Research Fellow, Gray Iron Founders Society, Cleveland . . . Started his business career with the Michigan State Highway Department as a clerk . . . Was connected with Michigan State College, foundry department, as molding instructor and was later appointed instructor in the metallurgy department . . . Became affiliated with the Michigan Sugar Co., Lansing, Mich., as chemist . . . Is a staff member of the Naval Research Laboratory and Chairman, Chesapeake chapter.

Ralph L. Lee

Nationally known speaker on the subject of employee relations, Dr. Lee presents in this issue *"Are Leaders Born or Made?"* . . . Member of the employee cooperation staff, General Motors Corp., Detroit . . . Native of Dayton, Ohio, where he received his early schooling, Dr. Lee has been associated with General Motors for twenty-three years . . . Served with Delco Light Co., Dayton, which later became the Frigidaire and Delco Products Division of the corporation . . . Advanced to assistant sales manager for Frigidaire before transferring to Detroit as assistant director of consumer research . . . Later joined the staff of vice-president in charge of sales before moving to his present position . . . Member of A.F.A. . . . Recognized authority on humanics in industrial operations, Dr. Lee is a frequent and popular speaker before A.F.A. gatherings.

H. E. Linsley

In this issue Mr. Linsley, author of numerous technical papers on aircraft engine production and manufacturing methods, presents a discussion of *"Core Ovens"* . . . Native of London, England, Mr. Linsley attended Hymers College, England . . . Joined Curtis Aeroplane & Motor Co., Buffalo, N. Y., as tool designer in 1928 . . . Became associated with Wright

Aeronautical Corp., Paterson, N. J., in the capacity of production engineer in 1933, and has been involved in technical public relations activities for the same firm since 1940 . . . Is a member of American Society of Tool Engineers, Institute of Aero Sciences, and Army Ordnance Association.

William E. Jones

Native of Wales, Great Britain, where he received his early schooling and served his apprenticeship with Sandycroft Foundry & Engineering Co. . . . Mr. Jones became associated with Killing Machine Foundry, Davenport, Iowa, as molder, in 1911 . . . Later in the same year joined Bettendorf Steel Foundry Co., Bettendorf, Iowa, as job molder . . . During association with this firm advanced to assistant foreman, foundry foreman and foundry superintendent . . . In 1942 became general foundry superintendent of Ordnance Steel Foundry, Bettendorf, operated by Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich. . . . A member of A.F.A., Mr. Jones is author of *"Atmospheric and Washburn Risers"* in this issue.

DISCUSSION WANTED!

The men who are recognized on these Who's Who pages each month have spent considerable time and effort in preparing their papers for presentation herein, and the value of their findings can be materially enhanced through discussion. Since oral discussion of these papers is not possible this year, written discussion is earnestly solicited!

Members of A.F.A. owe it to these authors to take a definite interest in their work. Written discussion should be forwarded direct to A.F.A. headquarters in Chicago, for publication in future issues of *American Foundryman* and/or future issues of *Transactions*.

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Trained Personnel Needed For Quality and Quantity Castings Production

AMERICAN Foundrymen's Association offers to the foundry industry the solutions to two problems which confront the industry today. These problems are: one, demands on the foundries for castings, both as to quantity and quality, which will tax their capacities for several years; and, two, the recruiting of foundry workers to help meet these demands. Complementing the latter problem is that of improving working conditions in the foundries.

Casting production, as to quantity, can be increased appreciably in most shops by the introduction of mechanical aids. Mechanical aids will help eliminate those disagreeable foundry operations which have given a "black eye" to the foundry industry. They also will mitigate the problem of recruiting and holding desirable personnel.

Castings production, as to quantity, can be increased through the use of improved methods in core-making, molding, melting, casting and cleaning techniques. Better housekeeping also serves as an incentive to better workmanship. It most certainly makes foundry work more attractive to those whom we wish to recruit.

The forthcoming 50th Annual Convention in Cleveland provides an answer to these problems. It offers to top management, and operating personnel, the opportunity to see and study the latest and best in foundry equipment. The various technical sessions provide information of interest to those who are interested in quality control.

Supplying another answer to these problems is the Technical Development Program through its four major branches, as outlined in its organizational chart, viz., publishing activities, investigations, library service and castings education.

Chapter meetings and regional conferences, sponsored by the A.F.A., provide a common meeting ground for the foundrymen in any one district to meet and discuss their plights. This interchange of ideas and experiences, especially through personal contact, not only helps solve these problems but also develops a friendship among the foundrymen in the district.

Thus the A.F.A. is fulfilling its purpose which is:

> ". . . To promote the arts and sciences applicable to metal casting manufacture and to improve the methods of production and the quality of castings . . ."

H. H. Judson, *National Director,*
American Foundrymen's Association.

HAROLD H. JUDSON, *National Director, American Foundrymen's Association, is foundry superintendent, Goulds Pumps, Inc., Seneca Falls, N. Y. He is well known for his developments in the production of high strength iron for large pressure pump castings, his paper on this subject was presented at the 1932 convention. In 1936 he prepared the A.F.A. exchange paper to the Institute of British Foundrymen. Was elected a National Director last year at the 1945 Administration Congress held in Chicago.*

GRAY IRON CASTINGS

WELDING AND SALVAGE

J. A. Griffin
Supervisor, Welding Salvage
Pontiac Motor Co.
Pontiac, Mich.

IT IS THE AUTHOR'S intention to bring out certain procedures and tried methods of salvaging gray iron castings through welding, brazing, arc, cylinder bore welding, soldering and plugging.

The tests for break load and deflection of welded and brazed specimens proved to be extremely interesting. The simple method used in the first experiment should be valuable in measuring the value of welders and materials used.

Brazing of cast iron, especially finished and semi-finished cylinder blocks, a method being used by the author as a reliable means of repair, will be discussed in detail. The photographs shown in the paper are those of actual repairs which returned the castings to production.

The photomicrographs show just what happens in the welding of cast iron. The discussion on the presence of high phosphorus in the welding rod and the weld itself should clear up some ideas as to its harmful effects from a physical standpoint.

Furnaces. The preheat furnace should be of the continuous or pusher type. It should be long and narrow, the length being sufficient to allow at least 1½ hr. heating time. The temperature at the end where the castings are entered should be as low as possible (about 350° F.). It should have no lighted burners closer than 8 ft. from the entrance. There are two heating zones, the first at about 800° F., and then the final zone or end of the furnace (1000 to 1100° F.).

This need not be an expensive furnace; in fact, one of the furnaces used by the writer consists of three batch-type furnaces placed end to end. The cold end was then added. Two rows of rails were placed through the furnace, allowing the cylinder blocks to slide, and trays were made for smaller castings. Two air pushers are used.

The cold end is the most important part of the furnace. This was added after many unsuccessful attempts at welding castings of complex design, although baffle plates and other means of diverting the heat from the light or heavy sections were used. Double-jacket castings are the most difficult to weld, but with the previously described furnace no difficulty was encountered with castings weighing up to 560 lb.

The furnace may be fired either by oil or gas, equally good results being obtained. The steel rails must be replaced almost every year. However, these may be cast in the foundry in castings of 4-ft. lengths. The rail has male and female ends to interlock for prevention of buckling.

How good is a weld? Is it as good as the parent metal? Methods of gray iron casting repair and salvage have been developed to the point of providing satisfactory answers to these questions.

The dimensions are smaller at one end to allow blocks to slide from one to another without binding. As much alloy as possible should be used to prevent corrosion and scale. These rails will give added wear and may be replaced in sections as needed. One of these rail castings is shown in Fig. 1.

Postheating Furnace. This furnace should be as long as possible. The lengths are not mentioned because they depend upon the production expected; however, the postheating furnace should be long enough to allow the castings to come out at temperatures of not more than 700° F., and much lower if possible. This depends entirely upon the type of castings being welded. A single line of rails will be sufficient with one pusher. The temperature at the front end of this furnace, for a distance of 6-8 ft., should be 1000 to 1100° F.

The best results are obtained if the welders load the furnace and push the trays or cylinder blocks as needed. This gives them a chance to remark the defect and get a good look at it while cold, which has several advantages. It gives the welders full responsibility for the casting from the time it is placed in preheat until it is welded and placed in postheat.

Castings are taken directly from the hot zone and placed on the welding bench with the aid of a hoist. Welding should start immediately. Slow welders should not be placed on this work because the time spent in welding and in getting castings into the postheating furnace is very important. For jacket welds the time

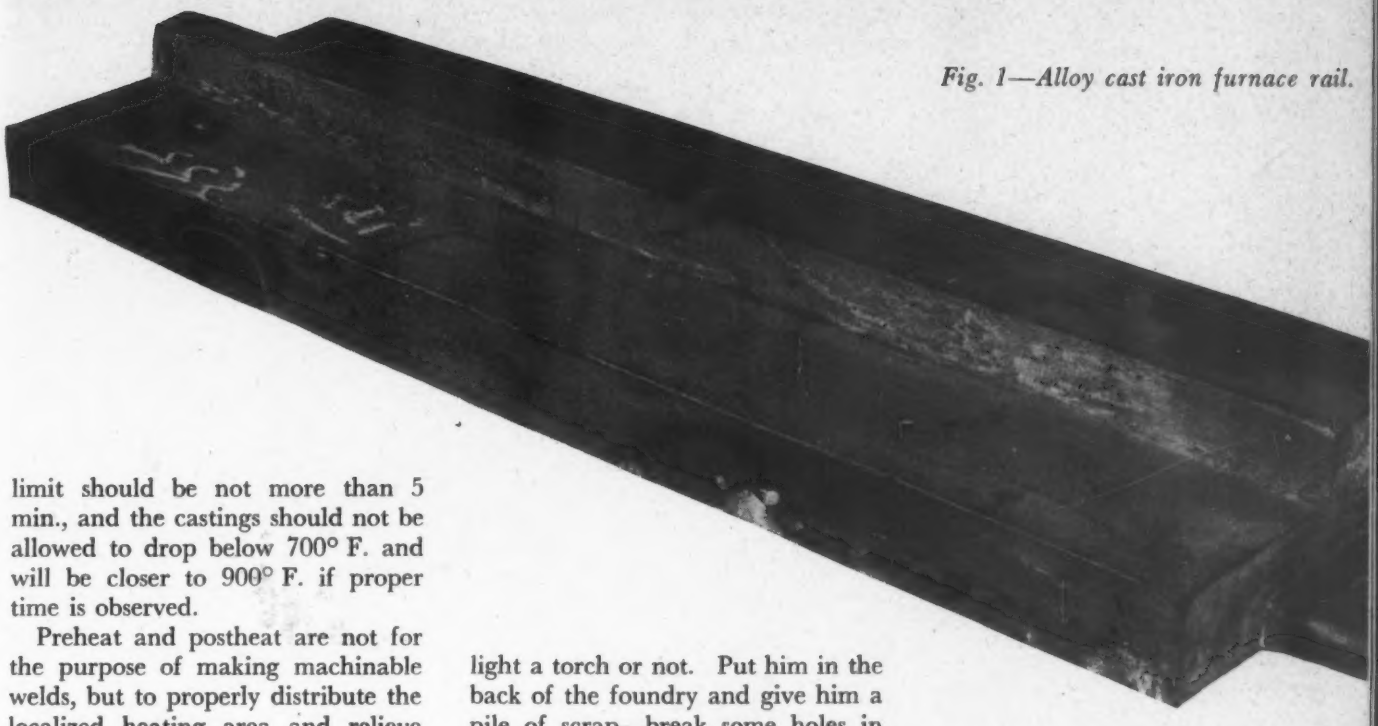

Fig. 1—Alloy cast iron furnace rail.

limit should be not more than 5 min., and the castings should not be allowed to drop below 700° F. and will be closer to 900° F. if proper time is observed.

Preheat and postheat are not for the purpose of making machinable welds, but to properly distribute the localized heating area and relieve stresses which may result. Making welds machinable is entirely the welder's responsibility except in castings so designed that the welder must work straight down into heavy sections such as tappet bosses in cylinder blocks. In such places the welder is unable to properly fuse the metal and welding rod, much less float off slag and impurities.

Such cases should be studied and other means of salvage used. It is not necessary to postheat all castings, or even preheat them. This depends entirely upon design; however, all jackets to be welded should be preheated and postheated. All jacket welds should be burned through and thoroughly cleaned with end of rod before welding.

This method of cleaning is entirely satisfactory except for bad scabs or buckles. A welder should never be allowed to plaster over a defect. He should follow these general rules:

(1) Use a good commercial flux.
(2) For heavy castings use No. 8 or No. 10 welding tip.
(3) Always use the same torch.
(4) Use rod free from chill of the approximate analysis shown in Table 1.

Having proper equipment, next in importance are good welders and a foreman capable of training them. A good method is to select a man who is interested in welding and has been doing a good job at grinding and finishing welds. It makes little difference whether he knows how to light a torch or not. Put him in the back of the foundry and give him a pile of scrap—break some holes in small castings and show him how they should be welded.

He should be kept at this for several hours a day, the rest of the time working on his own job. If after two weeks of welding, file testing and grinding this scrap he still shows a desire to become a welder, and if the foreman is satisfied that he will make a good welder, he should be given a chance. Place him on the job with a good welder or two working the kind of castings on which he received his training. Let him pick the easier welds for 30 days.

After this training period he should be able to take the work as it comes. However, it will be some time before he is ready for cylinder blocks and other jacketed castings. Welders trained in this manner become good welders and are always on the job. Experienced welders employed should go through at least a part of this training, not only to assure the foreman that they are capable but also to familiarize themselves with the castings being produced.

Welders trained in this manner have been checked in one foundry, and absenteeism for all causes, including sickness, vacations, etc., was less than 2 per cent for the year of 1944. Welding errors were less than 0.1 per cent.

Value of Good Welding. In recent meetings of engineers and foundrymen these questions have been asked: How good is a weld? Is it as good as the parent metal? If not, why not? All these questions and many more prompted the author to make the following tests.

A 3/4-in. hole was drilled in a casting. The casting was then preheated, welded, and postheated. Analyses were made of the parent metal, the welding rod (Table 1) and of the welded area. The difference in composition between the parent metal and the welded area is shown in Table 2.

This size of weld, although larger than the average weld, when prop-

Table 1

WELDING ROD ANALYSIS

Component	*Per Cent*
Total carbon	3.47
Silicon	3.07
Manganese	0.55
Sulphur	0.08
Phosphorus	0.61
Copper	None
Nickel	None
Chromium	None

Table 2

EFFECT OF WELDING ON COMPOSITION

	Composition, per cent			
Component	*Parent Metal*	*Welding Rod*	*Weld Area*	*Gain or Loss*
T. C.	3.11	3.47	3.33	0.22+
Silicon	2.59	3.07	2.72	0.13+
Manganese	0.64	0.55	0.55	0.09—
Sulphur	0.18	0.08	0.118	0.062—
Phosphorus	0.14	0.61	0.42	0.28+
Copper	0.5	None	0.13	0.37—
Chromium	0.17	None	0.07	0.10—

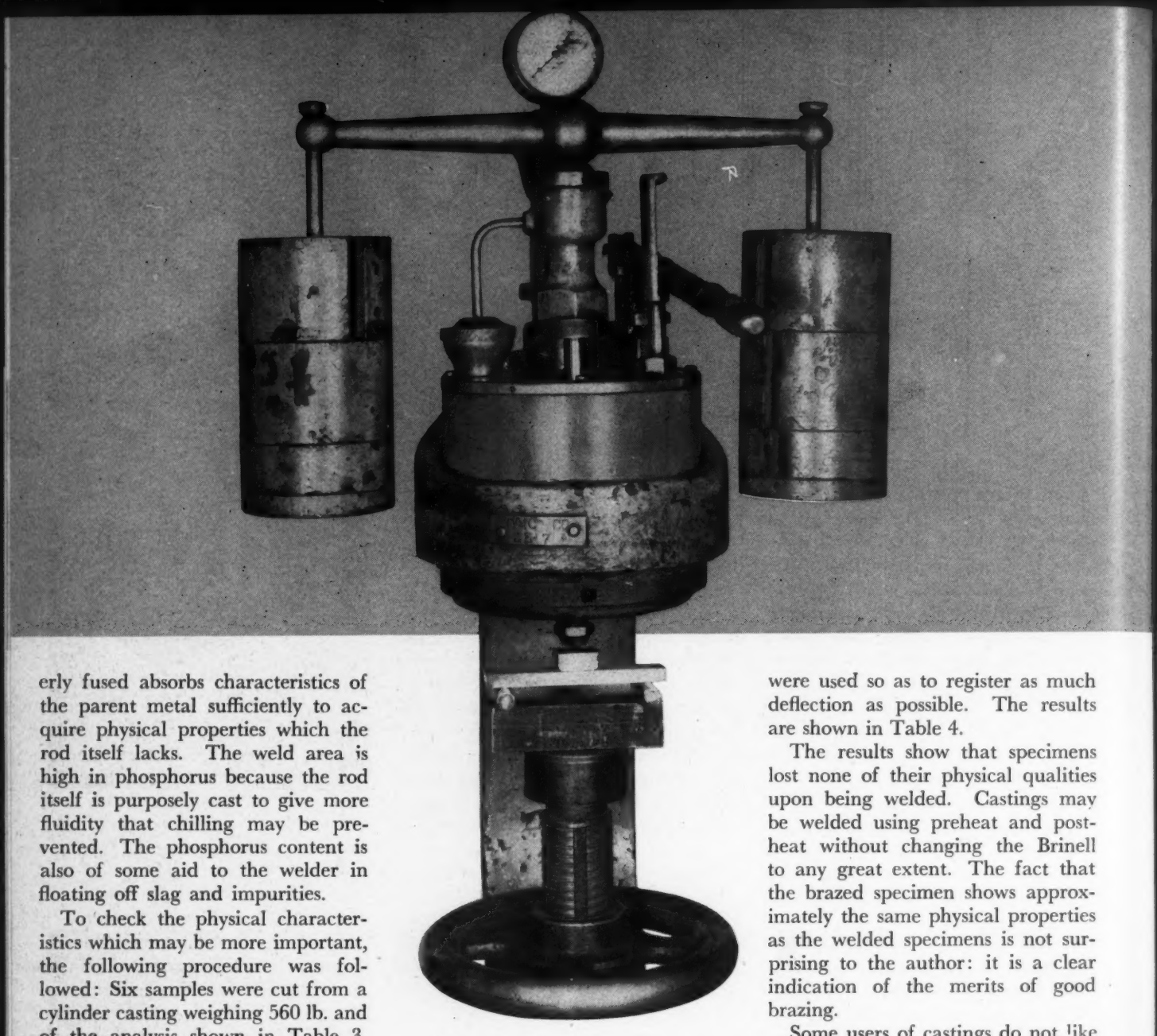

Fig. 2—Apparatus for testing relative values of welds.

erly fused absorbs characteristics of the parent metal sufficiently to acquire physical properties which the rod itself lacks. The weld area is high in phosphorus because the rod itself is purposely cast to give more fluidity that chilling may be prevented. The phosphorus content is also of some aid to the welder in floating off slag and impurities.

To check the physical characteristics which may be more important, the following procedure was followed: Six samples were cut from a cylinder casting weighing 560 lb. and of the analysis shown in Table 3. The specimens were of approximately 5-in. length, 3/4-in. width and 3/16-in. thickness, and are designated as *A, B, C, D, E* and *F*.

Specimens *A* and *B* were broken, preheated, and welded with a rod of the analysis shown in Table 1. Specimens *C* and *D* were preheated and postheated but not welded, *E* was left in the green state, and *F* was cut, edges ground and brazed together. The welds and the braze were as near the center as possible. The testing apparatus used is shown in Fig. 2, and consists of a steel block, two 1/2-in. steel pins, which may be moved to any centers, and a breaking block which is 1⅛-in. wide with corners rounded. This allows the sample to break at its weakest point.

The sample is placed as shown in Fig. 2, pressure is applied and dial noted when sample breaks. An indicator is placed at the breaking block and the deflection noted, which is important in evaluating a weld. The indicator is not shown, because it may be of any type and mounted in any way which will record the deflection or break. Three-in. centers were used so as to register as much deflection as possible. The results are shown in Table 4.

The results show that specimens lost none of their physical qualities upon being welded. Castings may be welded using preheat and postheat without changing the Brinell to any great extent. The fact that the brazed specimen shows approximately the same physical properties as the welded specimens is not surprising to the author: it is a clear indication of the merits of good brazing.

Some users of castings do not like the difference in color, and believe the quality has been depreciated. Various other brazing tests were made and all showed the same comparative results. This does not mean that brazing should replace welding, but it has a place in the salvaging of castings, as will be shown later.

Considering the specimens (Table 4) from a metallurgical point of view, sample *A* was prepared for photomicrographs. Figures 3 and 4 are of the weld area taken at 100 ×

Table 3

ANALYSIS OF TEST SPECIMENS

Component	*Per Cent*
Total carbon	3.37
Graphitic carbon	2.70
Combined carbon	0.67
Manganese	0.71
Silicon	2.15
Sulphur	0.127
Phosphorus	0.092
Nickel	0.22
Chromium	0.12
Copper	0.20
Molybdenum	0.07

Table 4

PHYSICAL PROPERTIES OF WELDS

Specimen	*Break Load, lb.*	*Deflection, in.*	*Brinell Hardness No.*
A	375	0.070	182
B	400	0.068	194
C	400	0.078	182
D	370	0.070	194
E	375	0.070	194
F	370	0.078	187

and 500 ×, respectively. These show the amount of steadite and its distribution. Figure 5 at 1500 ×, shows the lamellar pearlite which is near the nodular state.

The weld junction shown in Fig. 6 at 500 × reveals the mottled structure of pearlite, pine graphite in rather thick, short flakes, and some free ferrite. Some particles of cementite are present, but most of the white constituent is ferrite.

Covering the weld-affected area, which includes up to 3/4-in. from the weld proper, the photomicrograph (Fig. 7) taken about 1/2-in. from the weld shows free ferrite patches intermixed with graphite. This shows that this area was somewhat in the plastic stage during the process of welding. Little can be done to overcome this and, judging from the checks on physical properties, it has little if any effect. Figure 8 at 100 × shows the parent metal as having a slightly dendritic structure. Figure 9 at 1500 × shows the nature of the pearlite and the amount of free ferrite.

While the simple testing device used in connection with the hardness testing machine (Fig. 2) gave a good comparative check, it was not accurate from a laboratory point of view. To satisfy the more critical, tests were made on a tensile testing machine. The same device was used except that the tensile machine was used so that the break load could be recorded accurately in lb. Another group of samples were prepared from a cylinder block of the analysis shown in Table 5.

These samples were from a 180-lb. cylinder block which had remained in the mold 12 min. Samples *A* and *B* were broken, preheated, postheated and welded; *C* and *D* were preheated and postheated only; *E* left in the green state; and *F* was preheated, cut in two and brazed. Results are shown in Table 6.

From these results it can be stated that a weld, properly executed, is as good as the parent metal. The reason samples of a

Table 5

ANALYSIS OF TEST SPECIMENS

Components	*Per Cent*
Total carbon	3.24
Graphitic carbon	2.74
Combined carbon	0.50
Manganese	0.70
Silicon	2.43
Sulphur	0.142
Phosphorus	0.113
Nickel	0.15
Chromium	0.13
Copper	0.25
Molybdenum	0.04

Table 6

PHYSICAL PROPERTIES OF WELDS

Specimen	*Break Load, lb.*	*Deflection, in.*	*Brinell Hardness No.*
A	645	0.062	205
B	592	0.068	200
C	535	0.060	205
D	537	0.061	200
E	685	0.072	214
F	540	0.068	200

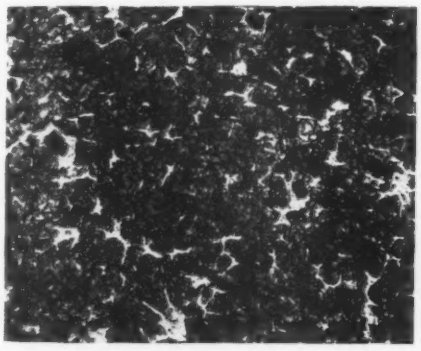

Fig. 3 — Photomicrograph of weld area. 100X.

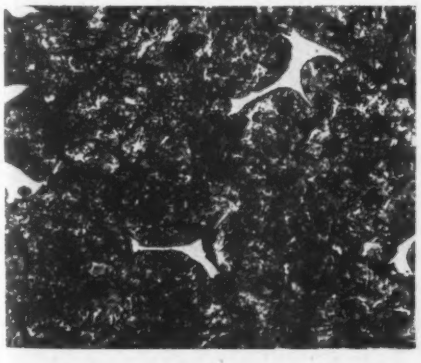

Fig. 4—Same area shown in Fig. 3 except 500X.

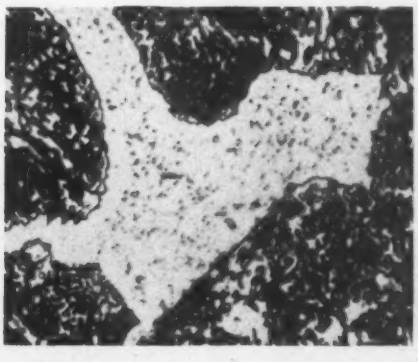

Fig. 5—Lamellar pearlite shown at 1500X.

Fig. 9—Same as Fig. 8 except 1500X.

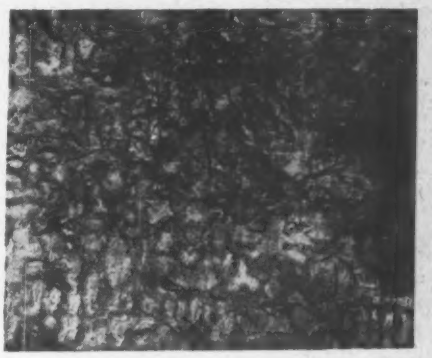

Fig. 8 — Photomicrograph showing parent metal to have slightly dendritic structure. 100X.

Fig. 7—Area ½ in. from weld shows free ferrite and graphite. 100X.

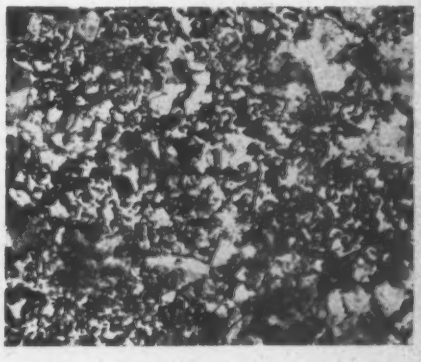

Fig. 6 — Weld junction. Pearlite, graphite, and some free ferrite. 500X.

Fig. 10—Cylinder block casting showing blow at cope pan rail.

Fig. 11—Cylinder block casting shown in Fig. 10 after repair by brazing.

Fig. 12—Cylinder block casting rejected because of shy locating pads.

Fig. 13—Same casting shown in Fig. 12 with brazed locating pads.

Fig. 14 (Upper Right)—Water pump casting rejected because of chipped snout. Fig. 15 (Above)—Cold arc welding the water pump casting (Fig. 14) with cast-iron flux-coated rod. Fig. 16 (Lower Right)—Water pump casting (Figs. 14 and 15) after being welded and ground.

thickness of approximately 3/16-in. were used is that about 85 per cent of the welding in this foundry is done with metal of that thickness. The brazed sample again showed the same comparative results. Both brazed samples broke about 1/4-in. away from the braze and neither showed any fracture at the bond.

Brazing Procedure. Castings to be repaired in this manner must be ground to solid metal. Flux is applied to the welding rod, and good quality flux is important. The casting is heated to a dull red at the point to be brazed, keeping heat away from the parts liable to be affected. The brass then is bonded to the parent metal and built up in a plastic state as fast as possible. An operator without sufficient practice to assure a good bond should not be allowed to braze. It requires an entirely different technique than cast iron welding. Once an operator has mastered brazing and uses it in the proper places, it is a great aid in salvaging cast iron.

Figure 10 shows a blow at the cope pan rail of a finished cylinder block. After cleaning out the defect for repair it was found to run into the bolt hole, which makes repairing difficult by most methods. This casting was brazed, and the repaired casting is shown in Fig. 11. A carbon was placed in the bolt hole, not screwed in but leaving enough stock for retapping without any further operation. The entire repair job was accomplished in 18 min.

Casting Finish

Figure 12 shows a rough cylinder block with shy locating pads. These could have been arc welded except for the fact that the rail, being high in the cope, is rather hard. Arc welding aggravates this condition and may cause a rough finish, and that finish being the main bearing race, no chances must be taken. Machining through the junction of a braze may be done without danger of encountering hard spots. The repaired cylinder block is shown in Fig. 13.

The author has used both Tobin and manganese bronze rods in brazing, with but little difference in the results. Either rod is recommended.

Arc Welding of Cast Iron. This operation is of a critical nature because of the many types of electrodes used and the many claims of their merits on castings of all designs and almost any state of completion. Arc welding, when properly used, has a valuable place in the salvaging of castings. However, it should be held well within its boundaries.

Arc welding may be divided into five types of repairs: (1) Preheat arc welding. (2) Cold arc welding rough castings. (3) Cold arc welding finished castings. (4) Cylinder bore welding or tack welding. (5) Intermittent welding, rough and finish.

Preheat Arc Welding. This is used to weld small defects which are clean. It is done by the welder after removing castings from the preheat furnace. Several small defects, not extending completely through the casting, may be present. He may arc weld these with a cast-iron flux-coated rod (note that this rod is of cast iron). He may then torch weld the major defect and stay well within the time limit. Many uses exist for this type of

Fig. 17 — Finished cylinder block casting showing blow at top face.

welding and this rod because its penetration is much greater than that of other rods and the weld remains soft.

Loose chaplets may be welded with assurance of being leakproof. The author does not recommend any type of arc welding of rough castings on machined faces except preheat arc with flux-coated cast-iron rod. This statement will meet with much opposition.

Cold Arc Welding. The use of this method on rough castings is limited. It should be used only on surfaces which are sufficiently heavy or designed to withstand the shock. Various kinds of electrodes are used, too many for the author to mention.

In Fig. 14 is shown a water pump with the snout chipped in handling. This casting is worth salvaging if a good, fast method is found. Figure 15 shows this casting being arc welded. The use of cast-iron flux-coated rod makes this weld extremely hard when not preheated, but the hardness makes no difference at this point, which is a hose connection and usually is hard when cast. Note that a carbon is used to eliminate as much grinding as possible.

Figure 16 shows one of these castings finished. They can be welded at the rate of 70 per hour. About six different electrodes will fill the needs for cold arc welding, but the one mentioned should certainly be included.

Arc Welding. On finished castings arc welding is done with one or more of the more expensive rods high in nickel, copper, etc., and flux coated. Castings should not be done too rapidly and, of course, at as low a heat as possible, using proper precautions. Repairs may be made close to cylinder bores and bearings without danger of distortion.

Figure 17 shows such a defect on a boss used for the number pad. A copper-covered flux-coated rod was used for this job. The results are shown in Fig. 18. Much more could be said on this subject, but the extreme example shows the merits of this type of repair, when properly used.

Cylinder Bore Welding. This method, although not new, has not been accepted by all engineers and manufacturers. Many millions of dollars worth of cylinder blocks have been salvaged by bore welding. The author would like to cover this subject as thoroughly as possible in order to clarify some of the doubt. The author has never encountered a single failure due to this method of repair. A good and successful procedure follows:

Fig. 18 — Same casting (Fig. 17) after arc welding.

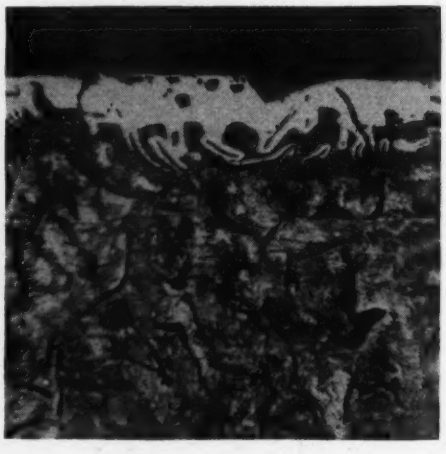

Fig. 19—Photomicrograph showing cylinder bore weld at weld junction. Top—100X. Bottom—500X.

A. The flow should be chipped or cleaned out by a right-angle drill. The casting should be scrapped if the flaw extends more than one-half the thickness of the wall. Flaws as large as 3/16-in. in ring travel and as large as 5/16-in. outside of ring travel may be repaired. Of course, there is a difference of opinion on these limits.

B. Bore-nickel rod of not greater than 5/32-in. diameter should be used. The rod should be of commercial purity, or not less than 94 per cent.

C. The welding transformer should provide 6 to 12 volts with high heat (350 amp.) such that the nickel rod is melted and scratched off the wire while in a plastic form. No continuous arc is held as this would result in a hard, heat-affected zone.

D. This welding operation should be performed by an operator of considerable experience who has demonstrated his ability with samples which have been cut and examined

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for hardness and bond. A microexamination of a cylinder-bore weld at the weld junction is shown in Fig. 19. The structure shows good solubility of nickel and iron at the weld junction. A relatively sharp line of demarcation between the nickel weld and the parent metal is shown. The cast iron structure at the junction seems to be barely affected. Figure 20 shows hardness transverse taken through a welded cylinder bore section with Vickers Brinell 10-kg. load and hardness recorded. Note that the hardness of the nickel deposit was increased from 166 to 203 by peening before the weld was ground. This has no effect on the weld junction.

Fig. 20—Hardness transverse taken through welded cylinder bore section.

Tack Welding

This method of welding (also called tack welding) is of great value in the foundry. It is used to repair imperfections and improve the appearance of the castings. Used in this manner it requires no particular skill. The author has several of these transformers placed in the cleaning room of the foundry for this purpose.

Intermittent Arc Welding. This method is similar to tack welding. In other words, it is not a continuous arc. It does not have the penetration of a straight arc, therefore is used mostly for repair of gasket surfaces, building up the edges of bolt bosses, etc. Its use is very limited due to the lack of penetration. A rod of about 74 per cent or more of nickel and 1/8-in. diameter is used. Little risk of damaging a finished casting is incurred with this method.

Cast Iron Soldering. This method of repair is a valuable aid in the salvaging of finished castings, and generally is used in the repairing of main and cam bearings in cylinder blocks. Spots which do not clean up, sand holes, small blows, and even small shrinks may be repaired and remachined without danger of damaging expensive tools.

Large areas at gasket faces may be repaired quickly. It may also be used on locating pads, where clamping is not too severe, and has a melting point of about 700°F. It is put on with a soldering iron which is at a dull red heat. It will not run and may be built up as high as is necessary. Commercially pure HCl should be used for the acid and surfaces must be clean. It is a time saver and does a much better job than welding when used within its limits.

Plugging. This probably is the greatest money saver in the salvaging of castings. The plug most commonly used is the 1/8-in. pipe plug of annealed cast iron. It has 27 threads per in., allowing a safe repair in metal thickness of 5/32-in. It is not advisable to use larger standard pipe plugs except in metal of greater thickness because these plugs have only 18 threads or less per in.

The author uses a 1/4 pipe plug with 20 threads per in. These cannot be procured on the market. However, the stock can be cast and annealed in the foundry and special tools may be ordered to make and use them. This plug allows a 1/2-in. diameter hole to be repaired in metal wall thickness of 5/32-in.

Conclusion

No attempt has been made to cover completely the subject of welding. X-ray testing and many other subjects relating to welding can be covered much better under their particular headings. However, the author hopes that this article will help to keep many castings out of the scrap pile, with an added assurance of safe and dependable methods of salvage.

Written discussions of this paper are solicited for publication in future issues of "American Foundryman" and/or bound volume of "Transactions." Discussions should be sent to Secretary, American Foundrymen's Association, 222 West Adams St., Chicago 6.

PATTERN ANALYSIS FOR BUYERS OF PATTERNS AND CASTINGS

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President
Master Pattern Co.
Cleveland

THIS ARTICLE is presented mainly as a guide for purchasers of patterns and castings, to assist them in the selection of equipment comparable to the number and quality of castings required.

Because of the broad variety of material, construction and methods of molding used in the foundry, and since each pattern is of an individual character and presents an individual problem in the number and quality of castings required, the selection of the most economical pattern from a practical standpoint is naturally difficult. This problem of selection will continue to vex the buyer at every purchase until some workable system has been developed for analyzing and directing the decision.

It is impossible to set down any hard and fast rule for the intelligent purchase of patterns. A great deal will depend on the experience of the buyer and his contact with the pattern and foundry industry. However, a brief analysis of certain factors will enable the purchaser to classify the equipment that will be the most economical for his requirements.

The use of this classification will not only help in the selection of the equipment but also will establish a common understanding between the buyer, the pattern manufacturer and the casting source. The importance of this mutual understanding should not be minimized. Mis-

Pattern Classification Chart

Large Patterns (Approx. 6 ft. or more). Locomotive and Large Machinery, Diesel Engines, etc.

*Production**	*Recommended Material*	*Recommended Equipment*	*Classification*
Low (10 to 20 castings)	Soft wood	Loose pattern	Class C-II
Medium (20 to 100 castings)	Soft wood	Cope and drag on boards	Class C-I
High (100 or more castings)	Hardwood	Cope and drag on boards	Class B-I

Medium Patterns (Approx. 2 ft. to 6 ft.) Automotive and Aircraft Engines, Machinery Parts, Housings, etc.

Low (10 to 50 castings)	(Machinery) soft wood	Loose pattern	Class C-II
	(Aircraft and auto) hardwood	Loose pattern	Class B-II
Medium (50 to 500 castings)	Hardwood	Cope and drag on boards	Class B-I
High (500 or more castings)	Metal	Cope and drag on metal plate	Class A-I

Small Patterns (Approx. 2 ft. or less) Machinery Brackets, Automotive Parts, Pipe Fittings, etc.

Low (10 to 30 castings)	Soft wood	Loose pattern	Class C-II
Medium (30 to 100 castings)	Hardwood	Pattern mounted on match board or metal plate	Class B-II
High (100 or more castings)	Metal	Cope and drag on plates —(or)— Match plate for small patterns	Class A-II Class A-IV

*NOTE: For less than 10 castings use Class C-III (see soft wood description) for all size patterns.

(A) Metal Description

Class A-I

Aluminum cope and drag on aluminum plates.
Aluminum pattern and core boxes machined all over to close tolerance.
Steel trim on wearing edges of pattern and core prints.
Steel face pattern plates at flask rests.
Core boxes to be steel faced to contour of core.
All loose pieces and loose piece seats steel faced.
Drier pattern and necessary driers, if required. (All driers to be heat treated.)
Core rubbing fixtures and core pasting fixtures, if necessary.
Core setting gages if needed.
Provisions for blowing and venting cores to be incorporated.
Blow holes and screens to be drilled and inserted by foundry, unless otherwise instructed.

Class A-II

Aluminum cope and drag on aluminum plates.
Pattern and core boxes cast to size and hand scraped.
Machined only where necessary for better fit or close tolerance dimensions.
Steel strip core box faces.
Drier pattern and driers. (All driers to be heat treated.)
Rubbing fixtures and core pasting fixtures, if required.
Core setting gages if needed.

Class A-III

Loose aluminum pattern and necessary aluminum core boxes. (Clean up job.)

Class A-IV

Aluminum match plate of cast patterns. (Clean up job.)

(B) Hardwood Description

Class B-I

Hardwood cope and drag on boards, if practical.
The best type of equipment consistent with high production foundry practice.
Sturdy construction of pattern and core boxes.
Steel strip at wearing edges of core prints and at flask rests of boards.
Steel face core boxes to contour of core.
Rubbing fixtures if required.
Core setting and core pasting gages if required.
Loose pieces and ribs to be aluminum.
Drier pattern and necessary driers, if required. (All driers to be heat treated.)
Carve all fillets in wood.
Material to be best grade of pattern mahogany.
Four applications of high grade coating.

Class B-II

Loose pattern, split if practical.
Good equipment consistent with casting requirements.
Sturdy construction of pattern and core boxes.
Leather fillets where practical.
Rapping plates to be inserted.
Material to be best grade of pattern mahogany.
Three applications of high grade coating.

Class B-III

A good pine pattern trimmed with hardwood wearing edges.
Hardwood ribs and core prints.
Hardwood faced pine core boxes.
Leather fillets.
Insert rapping plates.
Three applications of high grade coating.

NOTE: This type of pattern equipment (Class B-III) is not widely used, although it can be found practical in large equipments.

(C) Soft Wood Description

Class C-I

Pine cope and drag mounted on boards, if practical.
Best type of equipment consistent with high production foundry practice.
Sturdy construction of pattern and core boxes.
Rubbing fixtures, if required.
Core setting and pasting gages, if necessary.
Loose pieces, if any, to be hardwood.
Carve fillets where practical.
Use leather fillets where practical.
Material to be best grade of pine.
Four applications of high grade coating.

Class C-II

Loose pine pattern, split if practical.
Good equipment consistent with casting requirements.
Sturdy construction of pattern and core boxes.
Leather fillets used throughout.
Rapping plates to be inserted.
Material to be best grade of pine.
Three applications of high grade coating.

Class C-III

Loose pine pattern.
A satisfactory pattern for low casting requirement.
Material can be secondary grade of pine.
Wax fillets are permissable.
Two applications of high grade coating.

NOTE: Class C-III is recommended only for temporary and experimental patterns to be used for one or two castings. It is obviously necessary to keep the cost of the pattern to a minimum.

understanding may result in making equipment which will not give the best results in the production of castings.

For economical reasons a pattern must be designed to conform with efficient foundry production methods, and consideration must be given to dimensional accuracy, which frequently controls the amount of work in the machine shop. Consequently, a low pattern cost may bring about an increased cost of the product, and this is, of course, contrary to economy.

Proceeding with the analysis, the type of equipment and the material that should be used is frequently influenced by the size of the pattern. On large size patterns the cost of the metal used in the pattern may be prohibitive, whereas the cost of the metal on a small pattern is nominal.

The difference in the cost of a metal equipment and a wood equipment is not determined entirely by the material cost. For example, it requires a great deal more time to process a metal pattern, and this time element also exists between soft wood and hardwood patterns.

Other materials such as wax, plaster, white metal, etc., are used, but these are not generally employed in the finished product. They are exceptions and substitutions, used to expedite or for experimental purposes. Thus cherry and maple sometimes are preferred to mahogany and brass, and iron may be used in preference to aluminum.

Large size patterns (six feet or more) for low production (10 to 20 castings) and medium production (20 to 100 castings) are made in pine wood. Hardwood is most suitable for high production (100 or more castings).

Medium size patterns (two feet to six feet) for low production (10 to 50 castings) are made in pine wood. Hardwood is best for medium production (50 to 500 castings). Aluminum ordinarily is used for high production (500 or more castings).

Small size patterns (two feet or less) for low production (10 to 30 castings) are made in pine. Hardwood is best for medium production (30 to 100 castings). Aluminum is used for high production (100 or more castings).

Note that a low production (10 to 30 castings) for small size pat-

terns does not conform to low production for medium size patterns (10 to 50 castings). At the same time it must be borne in mind that there can be no consistency in these ratings—for example, 20 large castings may constitute a large order on one job, whereas 20 small castings would be a small order on another job. Therefore the size classification should first be consulted, after which the production rating is determined as either low, medium or high.

Selecting the Best Design

Having determined the size of the job as either large, medium or small, and the classification as to casting production as high, medium or low, the third step is to select the most practically designed pattern for the production requirements.

Where only one or two castings are to be produced it is obviously desirable to keep the cost of the pattern to a minimum.

The selection of the type of pattern—i.e., loose pattern, match plate or cope and drag pattern—is a determining factor in the amount of time that will be consumed in making the casting. Consequently this will be reflected in the pattern cost per casting.

A loose pattern makes no provision for developing a parting in the mold. The parting therefore is made in the sand by the molder. The time in developing the parting in sand will naturally affect the cost per casting.

Match plates are considered complete equipments and are used for small parts, a system which provides for the making of many small parts in one mold. A match plate equipment has a part of the pattern or patterns on one side of the plate and the remainder on the other side in perfect alignment and relation. The parting for the mold is developed on the plate.

Cope and drag equipments give the foundry the advantage of making each half of the pattern separately, the halves being held in perfect alignment by means of pins. The mold parting is established on the plates. This type of equipment generally is used for larger work and heavy production.

The Classification Chart accompanying this article deals with three sizes of patterns: Large, Medium and Small. Under each of these size groups a production schedule is shown which determines the recommendation for the material and type of equipment, as well as a classification number and letter. The classification number and letter refer to the respective Description Sheet, from which a detailed description of the recommended equipment can be determined.

By no means are the recommendations shown to be construed as final. Frequently, because of the character of the job (e.g., because it embodies cores) it may develop into a durable pattern. Some patterns are naturally fragile and the equipment may resolve into another group for classification. These exceptions can only be dealt with individually.

In using the Classification Chart, determine the following points:

(1) Size of the job (Large, Medium, Small).

(2) Number of castings required (Low, Medium, High).

(3) Recommended material (A—Metal, B—Hardwood, C—Soft wood).

(4) Recommended classification (Letters A, B and C; Classes I, II, III or IV).

(5) Refer to the Description Sheets.

The Pattern Classification Chart and Description Sheets will be useful in a general way, which is all that one can hope to accomplish.

A mutual understanding between the buyer, the manufacturer and the foundry source can be established by consulting the classification as outlined. Deviations will be necessary, of course, but they will be due to the size and shape of pattern, number of castings required, and the various methods of foundry practice.

By its very nature, the pattern industry presents infinite problems, each of which requires individual study. This article should be considered only as a step or system by which manufacturers of specialized products can pattern and classify their particular problems.

Acknowledgment

For assistance and advice in the preparation of this paper, grateful acknowledgment is made to Frank C. Cech of Cleveland Trade School, Cleveland, who generously contributed both time and knowledge.

Arblaster Presents First A.F.A.-Australian Paper

TO BE PRESENTED before one of the brass and bronze sessions at the 50th Annual Convention is the first exchange paper submitted by the Institute of Australian Foundrymen. This paper on "Manganese Bronze" is prepared by H. E. Arblaster, chief metallurgist, Stokes & Sons, Melbourne, Australia.

Mr. Arblaster attended Melbourne University and obtained a degree in

H. E. Arblaster

metallurgical engineering in 1935. He entered industry in a metallurgical capacity and spent four years in the electric welding industry as chief metallurgist, E. M. F. Co., Melbourne. His present position is with an established silverware firm, and their subsidiary, Stokes Foundries Pty. Ltd., a non-ferrous foundry. In addition to his industrial activities, Mr. Arblaster served as an evening lecturer in metallurgy at the Melbourne Technical College.

Foundries to Maintain High Employment Level

STIMULATED BY THE IMMEDIATE heavy demands for castings, foundry employment is expected to remain on the average of 50 per cent above the 1939 level, and even to approach that of the war-time peak, according to a study recently issued by the Bureau of Labor Statistics, U. S. Department of Labor.

Pointing out that the extensive mechanization of foundry operations may be offset by a return to the 40-hr. week, the study indicates a probable employment of 365,000 to 400,000 production workers.

CORE OVENS

Equipment and processing methods for cylinder head molds and cores and magnesium casting cores — construction and operation of baking and drying ovens — mechanical materials handling installations. Magnesium core sand mixtures identified by color system. Care and storage of cores in air conditioned storage rooms. Operation of sand reclamation system.

H. E. Linsley
Wright Aeronautical Div.
Wright Corp.
Paterson, N. J.

THE AUTHOR CANNOT, by any stretch of the imagination, be considered a foundryman. However, he can claim at least a nodding acquaintance with core ovens, having worked around gray iron, bronze, aluminum and magnesium foundries for more than 20 years.

The company with which the author is associated claims the distinction of operating the country's first aluminum and magnesium foundries designed solely for the manufacture of aircraft engine castings. While these may not be the largest foundries of this type today, they have provided a considerable fund of experience.

The heaviest production of the foundries is in cylinder heads, since 18 of these are required for each 2,200-hp. engine. They are poured in dry sand molds. Each cylinder head casting requires the preparation and baking of two half molds and six internal cores.

The cylinder head molds (Fig. 1) are made on rollover machines and are transferred directly to racks which travel on a conveyor chain between the double rows of molding machines. The molds weigh approximately 90 lb. each. At the end of the machine line the conveyor lifts sharply upward to enter the baking oven, which is carried on structural members 8 ft. above floor level.

The oven is a continuous conveyor type with an over-all length of 105 ft., and is so arranged that the conveyor chain carrying the racks must travel in multiple passes, a total distance of some 290 ft. through the preheating, baking, and cooling zones. A period of approximately 7 hr. is required for a mold to pass through the oven (Fig. 2).

Heating equipment is located at one end of the oven and consists of four pairs of external oil-fired burners. One burner of each pair operates continuously, while the other cuts in or out automatically to maintain a constant operating temperature of 450° F. Circulation is by means of induced draft fans mounted on the floor directly under the oven.

All continuous ovens are mounted overhead, thus saving floor space and allowing more comfortable working conditions by getting the heat nearer to the roof where it can be dissipated through ventilators. The open space underneath the ovens is convenient for storage, and in some cases box-type ovens are installed there.

After cooling the molds are sprayed with a fluoride solution, and then are loaded onto individual trays suspended from a conveyor chain, which carries them through a drying oven (Fig. 3). The drying oven is heated by means of an external gas-fired heater and is 16 ft. wide, 50 ft. long, and 5 ft. high. It is set on structural members, well above floor level. The oven is completely insulated with rock wool on walls, roof and floor, and is divided down its length by a sheet-metal partition to separate the two directions of conveyor travel.

Heat from the gas burners (Fig. 4) is blown through floor openings into a hot air spray duct mounted along the center line on the floor of the oven. The conveyor makes two passes through the oven in counter-flow direction and, when operating at the normal temperature of 325° F., requires about 1¾ hr. to pass a mold through.

The cores for the cylinder heads were, at one time, baked on the same equipment used for the molds, but the tremendous increase in production made it necessary to provide separate ovens for the purpose (Fig.

Fig. 1 (left)—Mold for aircraft engine cylinder head. Note the deep, closely spaced fins.

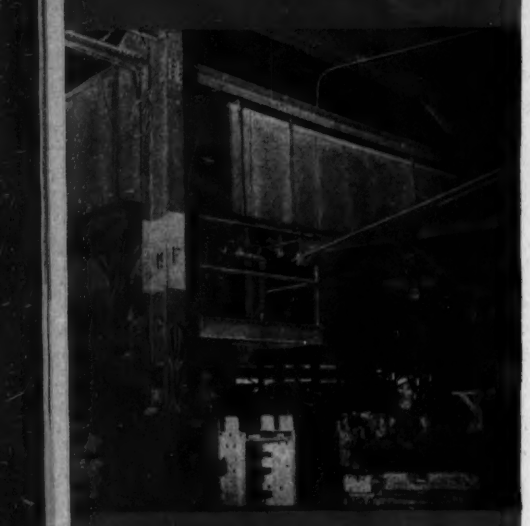
Fig. 2 (right)—Discharge end of oven used for baking molds shown in Fig. 1.

5). At the present time a tower-type oven, 10 ft. long, 10 ft. wide and 28 ft. high is being used. It has a capacity of 22 core racks, each of which has three shelves with an area of 15 sq. ft. per shelf. The operating temperature is 650° F., and production is 7.3 racks per hour.

The oven is heated by means of a proportioning type oil burner which fires into a refractory-lined combustion chamber. Recirculated air is mixed with the hot gases and introduced through a series of damper outlets into the evaporation zone and suction chamber.

Parallel or crossflow is provided in the oxidation or baking zone, with a neutral draft exhaust to the stack for spilling excess gas. A recirculating fan picks up the recirculated air and gases, and returns them to the wind box. The installation is, of course, completely protected with automatic temperature and safety controls.

In addition, the oven is equipped with ten individual, single-point recorders to show the temperature at each of ten zones. It is a well-known fact that uneven baking will



Reading (left) top to bottom:

Fig. 3—Entrance to oven for drying molds after spraying with fluoride solution.

Fig. 4—Fan and burner installation for spray drying oven.

Fig. 5—Automatic, tower-type core oven used for baking cylinder head cores.

Fig. 6—Natural draft cooling tunnel for cooling cylinder head cores leaving tower oven.

Reading (right) top to bottom:

Fig. 7—Core blower used for small and medium sized cores for magnesium castings.

Fig. 8—Core blower used for large magnesium casting cores.

Fig. 9—Stationary ovens for fragile and experimental cores.

Fig. 10—Continuous oven for baking production magnesium casting cores.

result in poor cores, and checking the temperature at just one point is not a guarantee that this temperature will be constant throughout the oven. The multiple check system enables the operators to spot any zones which are too hot or too cold and regulate the dampers accordingly.

Handling the Cores

The cores are made on core-blowing machines and are loaded directly onto the racks. As a rack is filled it is moved along by a power-operated roller conveyor which delivers it to the loading position in the front of the oven. Hydraulic jacks then raise the rack just high enough to clear the rollers and enable it to be pushed onto the carriers of the oven conveyor.

The racks travel up one side of the oven and down the other to the discharge position, where they are delivered to a second powered conveyor which carries them through a cooling chamber (Fig. 6). Cold air is drawn over the cores in this tunnel by natural draft, cooling them sufficiently to be handled with bare hands when unloading and placing on the storage shelves. The empty

Reading (left) top to bottom:

Fig. 11—Loading magnesium casting cores on a conveyor.

Fig. 12—Loaded core racks entering corebaking oven.

Fig. 13—Typical multipiece core for magnesium casting built up from a large number of separate cores.

Fig. 14—Oven designed for drying inhibitors in cores, now used as a paste drying oven.

Reading (right) top to bottom:

Fig. 15—Fan and burner equipment for spray drying oven.

Fig. 16—Loading and unloading end of core drying oven. Note proximity of core storage.

Fig. 17—General view of sand reclamation installation.

Fig. 18—Inside view of furnace showing one of the ten hearths over which sand is rabbled during reclaiming process.

racks are picked up by an electric monorail hoist and carried across the room to the starting point of the loading conveyor.

The development of the engine made by this company has resulted in an increased use of magnesium, with a corresponding decrease in the amount of aluminum. Of the parts originally made from aluminum, some 25 to 30 per cent now are made from magnesium. At one time both metals were handled in the same foundry, but the present practice provides for separate foundries.

Colors for Core Sands

All of the magnesium castings are made in green sand molds, but cores are, of course, baked in the usual manner. Anyone entering the magnesium coreroom could be excused for blinking rapidly and wondering whether or not he were seeing things, because he would see the familiar tan color of the sand blossoming out into dazzling hues of pink, and blue, and green. These colors are not used because they look pretty, but as a means of quick and positive identification of the different sand mixes.

Curiously enough, when the practice of coloring the sands was first started, the production rate of the women coremakers went up about 20 per cent. A bit of trouble developed with the girl who "just couldn't stand green," and the girl who wanted to work with blue sand because "blue was her favorite color," but that was soon straightened out. The dye is added in liquid form during the first mulling and, while it does not retain its full color after baking, it is still readily identifiable.

Core Blowing

In the newest foundry of the company many of the magnesium cores are machine blown. They range from small to very large cores (Figs. 7 and 8).

Since these cast parts are for an aircraft engine in which weight must receive first consideration, many of the cores used are exceedingly complex, and necessitate the use of light cross sections. Such cores must be handled with great care, and the inevitable slight jolting of a conveyor is sufficient to fracture them when in the green state.

Such cores are baked in stationary, three-compartment ovens heated by external, gas-fired heaters (Fig. 9). Each compartment is equipped with an individual heating, recirculating, and exhaust system, and each measures 6 ft. wide, 15 ft. long, and 6 ft. high. Doors are of the vertical lift, counterweighted type, and each compartment will hold two core racks with a load of 4,000 lb. per rack.

Normally these cores are baked for 4½ hr. at a temperature of 450° F., but a wide range of control is possible on each compartment so that special jobs or experimental work on new cores and new sand mixes can be carried on without interfering with routine production in the other ovens.

Regular magnesium cores are baked in a trolley conveyor oven, (Fig. 10) equipped with four-shelf trolleys (Figs. 11 and 12). This oven is 140 ft. long 20 ft. wide, and 9½ ft. high, and is located about 8 ft. above floor level.

Trolleys are spaced at 8-ft. intervals and travel at the rate of 37 ft. per hr., giving a capacity of 3,700 lb. of cores per hr. The oven is insulated by 5 in. of aluminum foil, and is divided lengthwise by a partition set off-center so that the first section accommodates one pass of the conveyor, and the second section houses two passes.

Heaters and Controls

The fully automatic, oil-burning heaters and controls, together with the circulating and exhaust fans are located at floor level near the entering end of the oven, the heaters being rated at 4,000,000 B.T.U. per hr., and the circulating fan having a capacity of 27,000 cu. ft. per min.

The air supply is conveyed from the heaters into two distributing ducts running along opposite sides of the oven, and is blown downward through special slots in the walls. This sets up a circulatory motion and induces a large amount of secondary air. The air moves in the direction opposite to that of the conveyor, and a large part of it is recirculated from the first pass of the oven. The remainder is exhausted from the entering end by means of the exhaust fan.

The oven originally was designed for an operating temperature of 450° F. at a time when this temperature was necessary for the type of core oil used. However, since the introduction of low temperature baking oils it has been possible to operate at 350° F. with a maximum entering temperature of 475° F. in place of the original temperature of 580° F. This has resulted in a tremendous saving of fuel oil.

Complex Cores

As previously mentioned, many of the cores are very complex and are built up from a considerable number of small, separate cores (Fig. 13). These cores are assembled and pasted to form a complete unit, and then spray dried in a conveyor oven (Fig. 14). This oven is of the continuous-trolley type, 94 ft. long, 13 ft. wide, and 6 ft. high, and is built similarly to the corebaking oven except that it is less heavily insulated because of its lower operating temperature of 300° F. Carriers are spaced at 8-ft. intervals, and each carrier has a capacity of 300 lb. of cores and plates. The rate of travel is 16 carriers per hr., which means that each carrier will remain in the oven for about 1¼ hr. This is insufficient time for the core to attain the full temperature of the oven but is sufficient to dry the paste.

At one time it was the practice to spray a sulphur-boric acid inhibitor over the surfaces of the cores and to dry this when drying the paste. This additional step was necessary because the high corebaking temperature burned out the inhibitors when they were mixed with the sand. Since the introduction of the low temperature baking oils it has been possible to mix the inhibitors with the sand without danger of their burning out, and the spraying practice has been discontinued.

Heating Equipment

The heating equipment consists of a two-section direct-oil-fired air heater, a supply fan capable of delivering 19,000 cu. ft. per min. at a temperature of 350° F. into the oven, and an oven exhaust fan. This equipment is located on the floor near the return section of the oven (Fig. 15) and delivers the heated air through continuous slotted ducts situated in the upper corners of each pass of the oven.

Recirculation is from the first pass only, and dampers are supplied to regulate the amount of air in each

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This paper was secured as part of the 1945 "Year-'Round Foundry Congress" and is sponsored by the Plant and Plant Equipment Committee of A.F.A.

Written discussions of this paper are solicited for publication in future issues of "American Foundryman" and/or bound volume of "Transactions." Discussions should be sent to Secretary, American Foundrymen's Association, 222 West Adams St., Chicago 6.

pass and the recirculation to the heater. The burners are rated at 2,000,000 B.T.U. per hr., and the normal operating temperature in the oven is 300° F.

Just before the entrance to the oven the conveyor chain is arched to clear a main aisle, and then makes a right-angle bend to pass the assembly benches for loading unfinished cores, and unloading finished cores into the core storage room (Fig. 16).

Core Storage

In one of the foundries is installed a completely dehumidified core storage room where, by means of batteries of silica-gel units, air heating and cooling units, etc., the moisture content of the air in the room can be brought down to a maximum of 13 grains per lb. This type of equipment is particularly important when cores are made on a production basis and held until required, since moisture in the core will react with the molten magnesium and produce hydrogen, which promotes burning of the metal and results in rejected castings.

It is not proposed to go into the details of this core storage room, which has been described in detail in the January, 1944 issue of *Heating, Piping and Air Conditioning*, but it is worth mentioning as indicating the care which should be taken in the handling of cores.

Reclaiming of Sand

Also of interest is a recently installed process for reclaiming core sand (Fig. 17). Without going into detail, this process consists of crushing the sand lumps, removing the wires and chills, and then passing the sand through a ten-hearth vertical rabble furnace where all carbon and organic matter are burned out, and clean white sand is returned to the foundries (Fig. 18).

It is estimated that this process saves the equivalent of 30 freight cars of sand a day, to say nothing of eliminating the eternal difficulty of used sand disposal.

Many foundry men are apt to assume that cores are something in which they have no proper concern except that the cores fit the molds properly and behave as they should. Granted that this is an age of specialization, with melter, pourer, coremaker, and molder each attending to his own phase of the work, the author feels that if each were to know at least a little about the other fellow's job he would find it of tremendous value in his own work.

Acknowledgments

In conclusion, the author wishes to express thanks to the various members of the Wright foundry staff for the assistance given in the preparation of this paper, and to *Industrial Heating* for permission to re-use certain material.

Judges Selected for Apprentice Contest

CHOSEN FROM the Cleveland area to minimize travel difficulties, judges for the National A.F.A. Apprentice Contest have been selected, and will meet to select winning entries in the week preceding the Annual Convention which opens May 6.

In order to be judged, entries must reach the Cleveland Trade School, 535 Eagle Ave., Cleveland, by April 27, marked for the attention of J. G. Goldie. Identified by number only, patterns and castings entered in the National Apprentice Contest should be labeled with yellow tags supplied by the National Office.

An apprentice need not be employed by an A.F.A. member plant to be eligible for the contest, which is open to all indentured apprentices not over 24. Ex-servicemen may enter if their age does not exceed 24 years plus the time spent in the armed services. Thus, a 25 year old veteran with two years of military service will be considered 23 for the purpose of the Apprentice Contest.

Apprentices will compete for cash prizes in each of four divisions of the National Contest—patternmaking, gray iron molding, steel molding and non-ferrous molding. In addition, the first prize winner of each division will be brought to the 50th Anniversary Foundry Congress and Foundry Show in Cleveland, May 6-10, to receive his prize.

Contest regulations, judging forms, blueprints, patterns and additional information are available upon request from the A.F.A. National Office. Write to American Foundrymen's Association, 222 West Adams St., Chicago 6.

Twin City Foundry Exhibit Proves Popular

PATTERNS and core boxes of the 1945 A.F.A. National Apprentice Contest recently were added to the foundry exhibit sponsored by the Twin City chapter.

The castings exhibit has been displayed several places in Minneapolis and St. Paul during the past six months. Starting with a few castings, molds and cores shown at a county fair, the Twin City chapter has added several hundred representative castings to its display. The exhibit has been shown at the J. J. Hill Reference Library and the Public Library of St. Paul, Minn., the University of Minnesota and the Public Library in Minneapolis. With the inclusion of the 1945 apprentice contest entries, the exhibit is being moved to the Minneapolis Vocational High School. Later it will be displayed by Twin City banks and public utilities.

Special trips were arranged by schools and youth organizations to allow children to view the exhibit. Student organizations at the University of Minnesota scheduled talks on castings to be given by local A.F.A. members and the university requested a permanent foundry exhibit.

Exhibits of castings made locally, and of apprentice contest patterns, have been used successfully by several chapters. The 1945 entries in the pattern division, A.F.A. National Apprentice Contest, have been used by several chapters in connection with chapter educational courses and technical meetings. These include the Toledo, Saginaw Valley and Twin City chapters, and a showing has been scheduled by the Philadelphia chapter. Use of the patterns and core boxes may be requested for an independent exhibit, to advertise local participation in the A.F.A. National Apprentice Contest or for incorporation with a castings exhibit.

ARE LEADERS BORN OR MADE?

TEST YOURSELF!

Ralph L. Lee
Employee Relations Dept.
General Motors Corp.
Detroit

EVERYWHERE I GO, foundry managers and owners tell me that among the thousand and one tough nuts they have to crack, probably the toughest of all is to pick or develop the right kind of individuals to supervise their people. Usually in discussing this problem with them I am asked (with a twinkle in the eye of the questioner) whether I think good supervisors are made or born.

From sad experience I know what I am getting into when I try to answer a question like this. To keep from sticking my neck out too far, I quote my old Grandpappy Lee, a molder by the way, who when he couldn't quite answer a similar question always started off by saying, "Well I would say it tis and it ain't, 'cause on one hand you might have this and then ag'in on the other you could have that."

I am not so sure, if Grandpappy Lee were alive today and was asked whether good bosses are born or made, but what his stock answer might not exactly fill the bill. On the one hand, we spend thousands of dollars and hours trying to make good bosses out of the human material we have on hand, but on the other hand, we know from long experience that there are some individuals who in spite of all the training, coaching and direction we can give them simply can't get the hang of handling other people effectively.

Facing this last fact many years

LEADERSHIP QUIZ

Yes	No	?	*Point Value*	*Question*
			(3)	1. He is not inclined to exaggerate.
			(2)	2. He willingly accepts practical suggestions from anyone.
			(4)	3. It is his nature to keep his voice down.
			(2)	4. He can be trusted with a vitally important secret.
			(2)	5. He is naturally inclined to say "we" oftener than "I."
			(3)	6. He always thinks before he speaks.
			(3)	7. He is a patient, attentive and open-minded listener.
			(2)	8. He is naturally inclined to get to the bottom of things.
			(4)	9. He has a keen sense of the right time and place to talk.
			(4)	10. He is naturally inclined to keep himself and things in order.
			(4)	11. He has earned the reputation of controlling his temper.
			(4)	12. He is naturally inclined to listen more than talk.
			(4)	13. He has the reputation of finishing what he starts.
			(4)	14. He has an unusually good memory.
			(2)	15. His opinions usually turn out to be right.
			(3)	16. He is the same all of the time, never way up or way down.
			(4)	17. He is always himself no matter whom he meets.
			(3)	18. He likes to win without rubbing it in.

ago started me off on a hobby I have ridden ever since . . . trying to find out the difference between the base metals of those who finally learn to lead and those who can't. In other words, the personal traits in common with those who make good bosses.

It seemed to me that if there were certain personal characteristics required to lead men which could be detected or developed, we could save one whale of a lot of training effort, one whale of a lot of labor friction and turnover and, far more importantly, one whale of a lot of heartaches on the part of those who failed to do what they were never cut out to do in the first place.

While I know I have not ridden my hobby horse over the finish line by any means, I do believe we are in on the home stretch. I have gathered together the answers to a question I have asked thousands of shop people: *"What are the personal traits you want in a boss you are willing to follow?"*

So many of the answers turned out to mean the same thing that I have been able to boil down the entire list to 36 questions. In examining each of the 36 under the microscope, so to speak, I found that they all definitely pointed to the fact that self-control and the ability to see through the other fellow's eyes are unquestionably the foundation stones of effective leadership.

The next thing I found was that there are many signs of this ability which almost anyone could recognize in another they had learned to know very well.

Then the thought occurred to

LEADERSHIP QUIZ

Yes	No	?	*Point Value*	*Question*
			(3)	19. He looks you in the eye when he talks to you.
			(2)	20. He has the courage to tell others what is what with self-control.
			(2)	21. He is extremely difficult to fool or mislead.
			(3)	22. He moves and works deliberately, never frantically.
			(2)	23. He rarely if ever has to hurry.
			(2)	24. He has sharp eyes with a sparkle in them.
			(3)	25. He suggests rather than orders or demands.
			(2)	26. He would rather help others do things than do them himself.
			(3)	27. He has a keen sense of humor and can laugh at himself.
			(2)	28. He naturally attracts others to him for personal advice.
			(3)	29. He gets a lot done with little fuss.
			(2)	30. He usually knows what he is talking about.
			(2)	31. He is neither a gossip nor a tattle-tale.
			(3)	32. He is definitely a man of his word.
			(2)	33. He rarely talks about himself or his possessions.
			(2)	34. He is completely wrapped up in his work.
			(2)	35. He is not of an envious or jealous nature.
			(3)	36. He does not hold grudges.

HOW TO SCORE YOURSELF ON LEADERSHIP

(1) The individual doing the appraising should read each statement and check it in the "True" column if it unquestionably applies to the person he is appraising, or in the "False" column if it does not definitely apply. If the appraisor does not know, he checks the "?" column. It is obvious that the appraisor must be well acquainted with the appraisee if the appraisal is to be accurate.

(2) If there is any question as to whether the statement applies, then the "False" column should be checked, even though the person in question has the characteristic in some degree.

(3) We all know that a subordinate is likely to put his best foot forward when he meets his superior. In view of this, the appraisor must be careful lest his appraisal reflect only his personal contacts with the person in question. We are trying to get at the individuals behavior in the presence of his associates and *his* subordinates.

(4) The best way to make an accurate appraisal is for three appraisors, each equally well acquainted with the individual, to make their own appraisals alone and then average the results.

(5) After all of the 36 statements have been checked, the values corresponding to each and indicated in parenthesis to the left of each serial number, should be added together. The sum of the values in the "True" column should indicate a measure of leadership ability or leadership potential. If all the statements apply, the score would be 100.

(6) It is obvious that too many checks in the "?" column indicate that the appraisor is not sufficiently acquainted with the appraisee to do an effective job.

me: Why not arrange these signs in the form of a guide for managers, superintendents, general foremen and others who face the job of selecting candidates for supervisory positions or of evaluating the leadership ability of their present supervisors. This I have done in the Group Leadership Appraisal Guide herein. You will notice that this Guide is in a form of a quiz answerable with "True," "False," or "?" instead of "I don't know."

If you care to try it out, you will find suggestions following the quiz on how to score each question.

So far, this method of appraising leadership is only in the experimental stage, but the results, as far as I have gone, are most encouraging. Supervisors who have proved their leadership ability beyond all question of a doubt invariably get top marks. On the other hand, those who are on the brink of failure, or who have definitely proven their inability to lead, without exception get low marks.

In spite of all of the work in developing and testing the Leadership Appraisal Guide, and the encouraging results obtained thus far, I personally do not think that this or any other appraisal system can be used as the sole guide for either selecting supervisors or evaluating them.

It seems to be the nature of us human beings to develop the talents we have to the point where they more than compensate for the ones we lack. The one-armed man becomes amazingly skillful with his one arm. One deaf ear seems to sharpen the hearing in the other. No matter what we do in the way of testing or evaluating leadership, the selection and development of leaders always will be, I believe, more of an art than a science.

In spite of this, we all know that far too many of our bosses are selected primarily on the basis of their mechanical ability or their knowledge of the business, with the ability to handle people playing second fiddle. Few will deny that getting people into the foundry and keeping them there once we have them, is our major problem today.

A supervisor who can develop a mutually satisfactory personal relationship with his people on a *Man to Man* basis is the best cure for turnover, and I am not so sure that such a supervisor is not also the most effective drawing card for attracting outsiders into the foundry.

In any event, it will certainly pay us all to try any and every means offered to help us do a better job of selecting and developing good leaders of foundrymen—and it might not be a bad idea to apply some of the medicine to ourselves.

Announce Topic for Convention Lectures

"FOUNDRY CONTROL METHODS" will be the subject of the Annual Lecture Course presented at the 50th Anniversary Convention in Cleveland, May 6-10, Annual Lecture Committee Chairman H. M. St. John, Crane Co., Chicago, has announced.

Always a popular feature at the Conventions, the course is expected to attract wide attention this year due to the increasing interest of foundrymen in lower costs and guaranteed quality. Speakers at the five sessions spread through the convention will discuss control methods for aluminum and magnesium, malleable, brass and bronze, steel, and gray iron foundries.

Recognizing the broad scope of the subject, the Lecture Committee plans to continue the series through the 1947 Convention. The material later will be published in book form.

A. F. A. Will Publish History of Industry

AS A PHASE of its educational work, A.F.A. shortly will publish an informative book on the HISTORY AND DEVELOPMENT OF THE METAL CASTING INDUSTRY prepared by B. L. Simpson, National Engineering Co., Chicago, to present the background of the foundry in its proper light and relationship to all industry.

The book now is being printed and it is hoped that copies may be available for the 50th Anniversary Convention, May 6-10.

The story of the development of metal castings is intensely fascinating, and is well handled by the author, who covers the period from the very early discovery of metal melting down to 1914. Scores of illustrations depict developments in metal melting, furnaces, molding, core making, patternmaking and the like; and the work deals chronologically with the most outstanding discoveries and inventions that have aided in advancing the art of metal casting to an established science.

The HISTORY AND DEVELOPMENT OF THE METAL CASTING INDUSTRY will be issued by the A.F.A. Technical Development Program as an aspect of the National Educational Program. It is planned to have copies included in libraries of schools and colleges throughout the country, and in public libraries as well with the cooperation of the A.F.A. chapters.

In all likelihood, many foundry executives will desire to make this book available to foundry personnel whose enthusiasm and knowledge of the foundry business may be enhanced through greater familiarity with the background of this most basic of all industries.

Foreign Founders Will Attend Annual Meeting

A DELEGATION OF TWELVE from the Institute of British Foundrymen, London, which will include Tom Makemson and John W. Gardom, Secretary and President, respectively, of the Institute, and Basil Gray, English Steel Corp., author of the 1946 I.B.F. exchange paper to the A.F.A., will attend the A.F.A. 50th Anniversary Foundry Congress and Foundry Show, according to advice from the I.B.F.

Shipping and currency restrictions have caused the British Government to restrict the number of delegates; and, therefore, announcement as to the remainder of the party cannot be made at this time.

According to present plans, the group will arrive in New York on or about April 21. The tour will include Philadelphia, Chicago, Cincinnati, St. Louis, Detroit, and Cleveland, and the party will return to New York after the convention.

A number of other European foundrymen are also reported attempting to arrange transportation, and, if successful, will meet the British party in New York to join in the tour and attend the convention. The former group may include: two from France, including Mons. P. Bastien, President, French Foundrymen's Technical Association; two from Belgium, one from Norway, one from Sweden, and two from Czechoslovakia.

ATMOSPHERIC AND WASHBURN RISERS

Steel Foundry riser practice, originally presented before the October 1944 meeting of the St. Louis District Chapter, American Foundrymen's Association . . . proper selection and use of risers results in sound castings and effects operating economies, particularly in the casting cleaning room.

W. E. Jones
General Foundry Superintendent
Ordnance Steel Foundry Co.
Bettendorf, Iowa

RISERS, atmospheric and Washburn, have been the subject of considerable interest in the steel foundry with which the author is associated. It is felt, however, that these risers, particularly the atmospheric riser, may still be largely in the experimental stage. Most of the work carried on in this plant with the atmospheric riser has also utilized a graphite rod.

Whether this method represents a truly atmospheric riser or not may be open to some question. In addition, some considerable experimentation has been conducted utilizing the Williams core, and the results in general have been excellent.

In the case of the atmospheric riser, when the metal is poured into the mold and fills the blind riser, it begins to freeze from the outside surfaces in contact with the mold toward the center of the riser. Should the freezing rate be too rapid, little feeding to the casting will be realized unless the riser is very large or some other agent is utilized to prevent the riser from freezing. With a Williams core placed in the proper location in the riser, the metal within the riser is subject to atmospheric pressure, thereby eliminating the establishment of a partial vacuum within the riser as the metal begins to solidify, the core acting as a passageway for the ingress of air.

The blind riser with Williams core inserted is diagrammatically shown in a section through a mold in Fig. 1.

Thus, with atmospheric pressure within the riser rather than a partial vacuum, the molten metal is free to flow and feed the casting.

Several advantages are obtainable in using a Williams core. This type of core can be made in a "gang" core box, which may either be blown or rammed, and therefore results in a low cost operation. With some care in design, a suitable core print may be developed which will be applicable to a number of similar molding jobs. This again results in further economies. Because of its simplicity, the Williams core may be inserted at the time that the mold is being rammed, thereby saving the time of setting and nailing the cores when the mold is being finished.

Use of Graphite Rods

Some considerable experience has also shown that the utilization of graphite rods in blind risers is advantageous. When a graphite rod of the correct size is properly located across the diameter of the riser, the pipe or shrink cavity within the riser will be shallow and well rounded rather than long and taper-

Fig. 1—Diagram of mold section illustrating use of blind riser with Williams core.

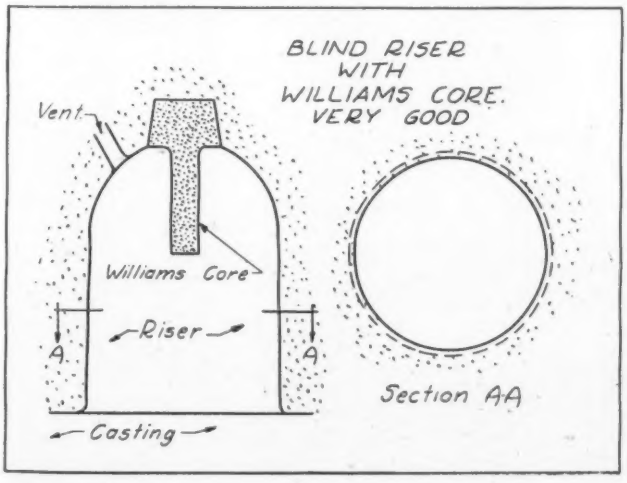
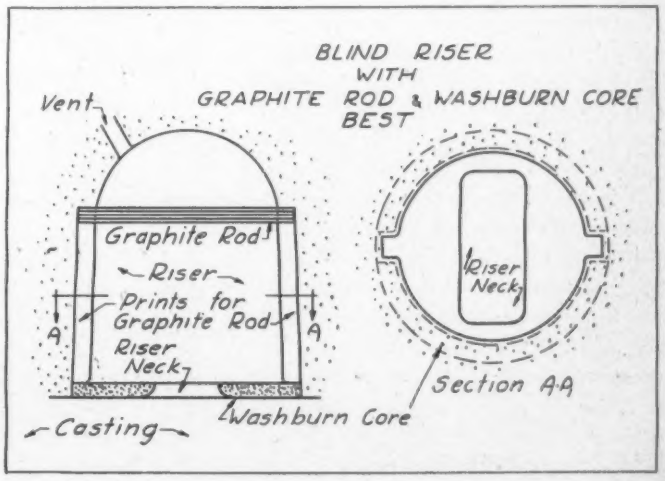


Fig. 2—Sketch showing use of blind riser with graphite rod and Washburn core.



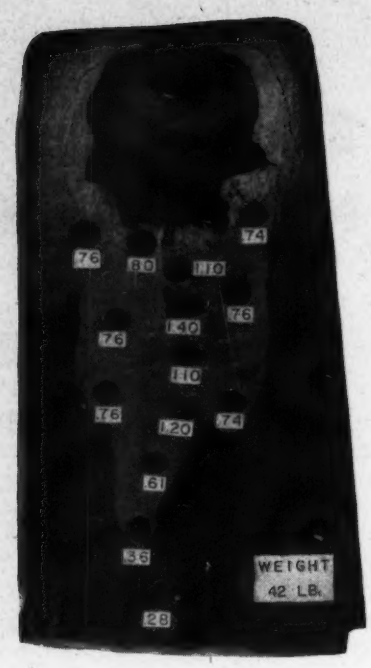


Fig. 3—Typical sections through two risers, one of which (above) contained a graphite rod.

ing. (The location of the graphite rod is diagrammatically shown in Fig. 2.)

A long, tapering, shrinkage cavity within the riser may extend to the casting proper or, to a lesser degree, may cause porosity in the casting adjacent to the riser. In other words, with the use of the graphite rod, the shrinkage cavity will be shaped like a carrot, which obviously is not desirable for reasons already enumerated. By changing the shape and location of the shrinkage cavity within the riser, it is possible to reduce the size of the riser and yet obtain a sound casting.

Figure 3 shows a typical section through two risers, one of which contained a graphite rod. Attention is particularly directed to the amount of metal saved in the reduced size of the riser and the carbon pickup by the steel from the graphite rod, as indicated by the numerical values shown on the photographs.

This change in the character of the shrinkage cavity is quite likely due to the metal having remained in the molten state for a longer period of time, permitting more efficient feeding of the casting. The molten steel in the riser has dissolved carbon from the graphite rod and thereby lowered its freezing temperature, maintaining fluidity for a greater period of time for the feeding of the casting. It is also possible that the hot graphite rod may burn to some extent and liberate a small amount of heat to further delay solidification.

Since graphite has a relatively high thermal conductivity and heat capacity, the diameter or size of the rod and its location in the riser is of considerable importance. A rod which is too large in diameter will cause excessive carbon pickup by the steel and result in a high carbon area within the casting.

Secondly, for reasons of economy, the graphite rod should not be larger than necessary. If the graphite rod is placed too close to the casting, the steel in its immediate proximity, always higher in carbon, may cause an objectionably high carbon concentration in the casting itself. A graphite rod which is too small, on the contrary, will not achieve the desired results, and instead of yielding a shallow shrinkage cavity it will tend toward an elongated or carrot-shaped type.

The diameter of the graphite rod is largely one of selection based upon actual experience for each particular molding job, and quite naturally will vary with the volume of metal within the riser. The manufacturers of graphite rods recommend the following sizes:

Recommended Graphite Rod Sizes

Riser Diameter, in.	*Graphite Rod Diameter, in.*
to 3	3/16
3-5	1/4
5-8	5/16
8-12	3/8
12-15	1/2
15-18	5/8
18-20	3/4

The location of a graphite rod relative to the casting is of considerable importance. If too close, it will cause a high carbon area within the casting, and if not close enough it will be ineffective in reducing the length or height of the riser. The graphite producers recommend that the rod be located a minimum distance from the top of the riser equal to approximately one-half the riser diameter. Experience in the author's plant has shown that the best results are obtained when it is located one-third of the height of the riser as measured from the top of riser.

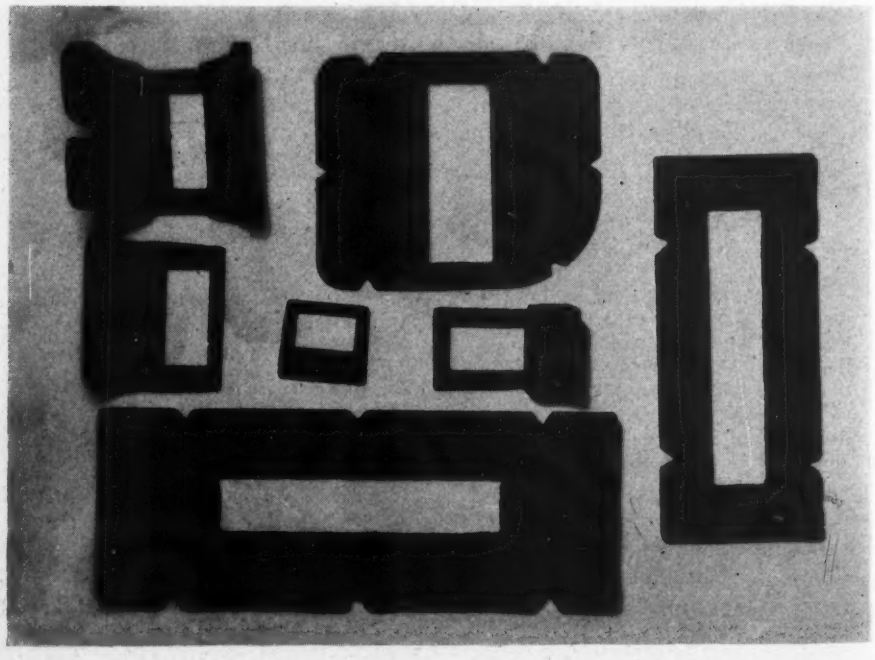


Fig. 4—Several sizes and types of Washburn cores.

The use of the Washburn riser has been so successful in this plant that it is now standard practice to use it wherever possible. It has paid dividends in saleable castings and decreased production costs.

The Purpose of the Washburn Riser

The basic principle of a Washburn riser involves the utilization of a relatively thin core which constricts the riser at the point of attachment to the casting, thereby minimizing the cost of burning off a large riser. The advantages of a heavy riser are retained, since the thin core heats quickly to a relatively high temperature so as to insure feeding of the casting.

The Washburn riser core also has additional advantages in the molding room. It is easily set into the core print, nailed securely, and the job is accurately and uniformly performed. By comparison, the standard riser must be rammed hard, secured or nailed, rounded off with a molder's slick or trowel, and finally scab-nailed. Rarely will two molders (or, in fact, even the same molder) make the same riser identical on two successive molds.

Making a Washburn Riser

Several steps are involved in making a Washburn riser. An attempt will be made to describe briefly the methods utilized in the author's foundry.

First, the location of the riser on the pattern is determined. A frame of wood or modeling clay is then placed around the spot chosen for the riser, this frame being at least 1 in. larger than the size of the riser. The frame is then filled with plaster and given the exact contour of the pattern. When set, the plaster cast is removed and trimmed to proper shape so as to provide for a draft, size and thickness, which should be held to a minimum at the point where the riser joins the casting. The minimum thickness or neck of the riser is dependent on the size and shape of the riser and should be approximately ¼ in. to ½ in.

The plaster print is now placed on the pattern in its proper location, and a plaster frame about 1¼ in. wide poured around the outside contour of the print and struck-off level with the top of the print. Both pieces are then removed, turned face down and a plaster core box

Fig. 5—Example of conventional type of riser. Note large heads which have been burned off.

Fig. 6—Same casting shown in Fig. 5 except made with Washburn risers which have been knocked off.

Fig. 7—Casting made with Washburn risers which can be knocked off.

Fig. 8—Another illustration of the advantages of the Washburn riser.

bottom poured over both, utilizing some sort of frame to serve as the core box. The outside frames having been trimmed to size, the riser is placed in position on the bottom core box pattern.

The three pieces described are then sent to the aluminum foundry so that castings may be made. After the castings are filed smooth, the core print is fastened to the pattern with screws. The outside portion is dowelled to the bottom part of the box with four pins which extend through the frame to the top of the box, thereby serving to carry the core print when it is turned over.

The method outlined for making these core boxes is only one of a number of methods available where the position of the core will not afford back draft in the core box. Frequently, simple gang dump boxes can be used. (Fig. 4 shows a number of typical Washburn riser cores.)

Washburn Core Mixture

It is necessary to have good hard cores, otherwise the steel will penetrate or burn into the core, making the risers difficult to knock off and, if large, much more difficult to burn off. The particular core mixture utilized in the author's foundry is as follows:

Crude Ottawa Silica Sand, lb.	2,000
Silica Flour, lb.	200
Cereal Binder, gal.	6
Core Oil, gal.	4
Moisture, per cent	4.4–4.8
Permeability	75
Green Compressive Strength, psi.	3.3

If there is a tendency for steel to penetrate or burn into the core, an addition of 100 lb. of silica flour is added to the above core mixture, making a total of 300 lb.

Burning, Chipping, and Cleaning

On most castings where Washburn risers have been used, the risers may be knocked off easily with about three blows of a heavy sledge-hammer. This eliminates the necessity for cleaning or chipping away the sand that has burned onto or has adhered to the casting before cutting off the riser with the oxy-acetylene torch, since the latter will not burn through adhering sand. Burning off risers with an oxy-acetylene torch is in itself costly and particularly difficult where the riser is placed on a curved surface.

After burning off the risers, particularly large risers, the casting generally is covered with metal and slag, necessitating considerable labor in removal. Relative advantages of the Washburn riser versus the conventional type riser are clearly portrayed in Figs. 5, 6, 7 and 8.

A casting on which a Washburn riser is used arrives in the cleaning room requiring only snag grinding and is finished insofar as risers are concerned. In any case, a minimum amount of burning will be required prior to grinding. Thus, when compared with usual practice where the ordinary riser is used, the burner either burns too low and gouges the casting proper (requiring costly welding repairs) or else, to avoid this, leaves the riser too high, requiring costly grinding operations.

Based upon experience in the author's foundry, it would appear that the Washburn riser will reduce labor in the cleaning room, a constant bottleneck in any steel foundry, and, in addition, will result in decreased production costs.

Analysis Committee Is Abstracting Articles

THE A.F.A. COMMITTEE on Chemical Analysis is reviewing and abstracting articles of interest to foundry chemists from approximately 80 periodicals.

Committee Chairman Carl Sweet, Minneapolis-Moline Power Implement Co., Minneapolis, has arranged to have committee members prepare abstracts for publication in AMERICAN FOUNDRYMAN.

One of the main objectives of the committee is to "review literature . . . and report new methods applicable to the foundry industry."

Cooperating in this service are committee members M. Ralph Berke, consulting chemist, Ottawa, Ont.; Fred Boxmeyer, Northern Malleable Iron Co., St. Paul, Minn.; Marc Chicoine, The Robert Mitchell Co., Ltd., Ville St. Laurent, Que.; Ben J. Grimm, Twin City Testing & Engineering Lab., St. Paul, Minn.; Donald Grimm, Auto Specialties Mfg. Co., St. Joseph, Mich.; Carl Johnson, Minneapolis Electric Steel Castings Co., Minneapolis; Gordon W. Johnson, American Hoist & Derrick Co., St. Paul, Minn.; A. H. Lewis, Dominion Engineering Works, Ltd., Montreal, Que.; J. P. McAvity, T. McAvity & Sons, Ltd., St. John, New Brunswick.

Past President Utley Dies in Detroit

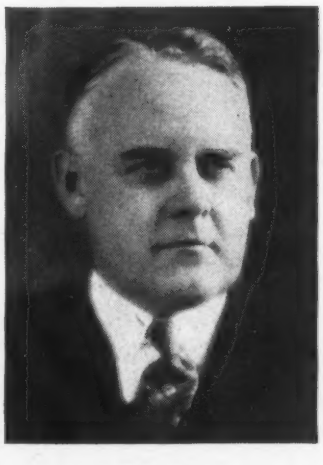
S. WELLS UTLEY, Past President, American Foundrymen's Association, died at his home, 1964 Edison Ave., Detroit, early Wednesday morning, February 13 of a heart ailment.

As President of A.F.A., he presided at the Edgewater Beach Hotel Convention, Chicago, in 1927 and the Philadelphia Convention and Exhibit in 1928. He and Mrs. Utley were members of the delegation to the International Foundry Congress in London, 1929.

Subsequent to his service as President of A.F.A. he served as President, Detroit Board of Commerce; President, National Founders Association, the Employers Association of Detroit, and the Michigan Manufacturers Association.

Born in Pontiac, Mich., June 25, 1879, he was graduated from the University of Michigan, Ann Arbor, in 1902. He was employed by the American Radiator Co. for three years, and in 1906 obtained a position as cost clerk with the Detroit Steel Casting Co. with which company he held positions as assistant secretary, secretary, and vice-president; becoming president in 1930.

Mr. Utley was the author of numerous treatises on economic subjects and a member of the Board of Directors of the Economic Club and the Board of Directors of the National Assn. of Manufacturers.



S. Wells Utley

GOLDEN ANNIVERSARY CONVENTION

GROWS LARGER

A BROAD-SCOPE PROGRAM of specific-information papers and discussions, which will assist foundrymen materially in their huge peacetime task of meeting the needs of reconverting industry and speeding production of peacetime goods, will feature the Golden Jubilee A.F.A. Foundry Congress in Cleveland May 6-10.

While the Congress will bring into strong relief the tremendous technical and other advancements of the cast metals industry over the past half century, the more than 60 special and general interest sessions programmed by Association committees are definitely reconversion and peacetime in concept. In combination with what promises to be the largest and most interesting of foundry equipment and materials expositions, they not only will reveal and fit together war-born developments of wide and important peacetime application, but also will suggest many other production and management refinements invaluable in solving output problems ahead.

The Golden Jubilee Foundry Show, still growing in number of exhibitors and acres of booths, is expected to "let the cat out of the bag" on scores of products and processes quietly developed to speed castings production for war, and unveil many ingenious developments of standard equipment and materials of peacetime service to foundrymen.

The exposition outgrew by mid-February original floor plans involving 100,000 sq. ft. in the Exhibit, North and Lakeside Halls and the Arcade of Cleveland's Public Auditorium. Thereupon the Association opened the auditorium's vaulted Arena, initially planned as a restaurant and lounge, to non-operating and service exhibits, increasing to more than 116,000 sq. ft. the space allotment for an "all-out" show which will offer excellent opportunity for thorough-going study of the application of equipment and materials of all types to post-war modernization plans.

The restaurant, planned for the Arena of the Auditorium, will be located in the South Hall. That area will also afford space for a quiet, attractive lounge and local and long distance telephone facilities.

Diversified Technical Schedule

Symposia, panels, round tables, practical shop courses, highly informative lectures, luncheon and dinner meetings, "information, please" sessions make up the "technical" program, designed this year to stress progressive processes and cost and time-saving techniques in the interest of quickly expanded high-level production for civilian uses.

The annual lecture course, in reflection of the wide appeal of its previous presentations, has been expanded to five sessions, one each day of the Congress. Foundry control methods for producers of aluminum, brass, bronze, gray iron, malleable and steel castings will be covered in the series.

A sand shop course also is scheduled for each of the five days of the Congress. Expected to prove highly popular and instructive, these sessions will deal with sand control in the casting of brass, bronze, gray iron, malleable and steel. Foundry sand research will come in for two sessions May 8, when the Congress hears a progress report, the sixth annual, titled "Physical Properties of Foundry Sands at Elevated Temperatures." Papers dealing with heat absorption of sand and clay and fineness determination will also be presented.

Non-Ferrous Program

Features programmed by the Association's Aluminum and Magnesium Division include papers, round table discussions and committee reports embracing a broad field of progress and interest. Among topics scheduled for attention are heat treating, centrifugal casting, dimensional stability, effect of mold materials, microporosity, and recommendations in the matter of aluminum and magnesium permanent molds. Committees of this Division concerned with reclamation, alloying and sand castings will meet May 6. The Division's test bar committee meets the following day.

Brass and Bronze Division sessions, opening May 8 to run through the last three days of the Congress, will discuss knock-off risers, use of insulating pads for riser sleeves, combustion for crucible melting, and distribution of mechanical properties in sand cast bronze. Methods of sealing through heat treatment also will be discussed.

Other highlights of the brass and bronze sessions will be the exchange paper of the Institute of Australian Foundrymen—a discussion of manga-

nese bronze and standards of its manufacture in Australia, and the presentation of an advisory committee report prepared for Army Ordnance on "Manganese Bronze."

Ferrous Highlights

Two of the five sessions scheduled by the Gray Iron Division will be symposia concerned with engineering properties, a third will deal with the welding of gray iron, and the others will have a more general character. Among topics programmed are wear resistance, heat treatment, and relationships between section size and mechanical properties and between hardness and tensile strength. A paper on "Fatigue Limit and Notch Effect of Gray Iron" is also scheduled.

The metallurgy of cupola mixes, carbon control in the cupola, and castings defects attributable to metal will be dealt with in the gray iron shop course sessions to be held May 6-9, inclusive.

Malleable core practice will be the major subject of the Malleable Division's session. Coremaking in automotive and large mechanical foundries will be thoroughly covered and attention also will be directed to malleable iron chemistry. At the Division's round table luncheon melting, test bars, and sulphur-manganese ratios are to be topics.

Foreign Papers

Techniques not common in American practice will be disclosed at one of the Steel Division's sessions which features presentation of an IBF exchange paper dealing with the production of "tall boy" and "grand slam" aerial bombs. That session will also present two Russian foundry technicians who have as their topics "The Susceptibility of Steel to Hot Tear Formation in Castings" and "The Technological Principles of Castings Design."

Other steel symposium subjects are thermal relief of stresses, blind risers, heat treatment, bore cracks in valves and fittings, and the production of steel for castings. A round table luncheon is scheduled for May 9.

Accident prevention in foundries will be viewed as one of the important functions of management at one of two sessions scheduled as joint meetings of the plant equipment and safety and hygiene committees. A panel on dust equipment and a paper on "Mechanical Shakeouts" will be presented.

Inspection of castings, commonly termed the "backbone of quality control," will be discussed the morning of May 9 and again that afternoon when a panel session will present viewpoints of the castings buyer, the sales department, the engineer and the foundry inspection department. Refractories will be viewed from half-a-dozen angles the afternoon of May 7 and will become a "Question and Answer Panel" topic that evening.

Included in the wide range of management interest subjects on the program are "current problems," cost methods, job evaluation and time study, foreman and apprentice training, and the ever-important matter of cooperation with engineering schools.

Small-shop owners and managers will be especially interested in the cost system sessions, while management of small and large foundries alike will be attracted to the training sessions which have for consideration the "Human Relation Problems Involved in Apprentice Training," the foreman as "Engineer of Human Relations," standard and accelerated apprentice programs, upgrading systems and the timely subject of veteran training. An equally informative program will feature the apprentice training dinner meeting May 9.

Engineering student training will be covered by a panel on "College Graduates versus Employers." Another high-interest panel meeting is on "Time Study and Job Evaluation," topics that again will be considered specifically from management's viewpoint in a paper presentation the afternoon of Thursday, May 9.

For those whose chief interest is the patternmaking department, that Division of the Association has an important schedule of papers for the afternoon of the fourth day of the Congress. The Division's executive and program committees will meet for luncheon that day.

The annual banquet will climax the Congress with an address by a national figure. The President's annual address will be presented May 9 at the annual business meeting, which opens at 9:30 am and includes election of new officers and directors, the Foundation Lecture, and the announcement and presentation of awards for outstanding foundry field achievements. Engineering school alumni groups will stage a luncheon session May 7; chapter officers and directors will hold their meeting that evening, and foundry instructors will gather for their annual dinner May 8. The "Alumni Dinner," a meeting of past presidents and other former national officers and directors, is scheduled for Thursday evening.

On Northeastern Ohio Day, Thursday, May 9, exhibits will remain open until 10:00 pm to enable a maximum number of the shop men in foundries in Cleveland and neighboring areas to visit the exposition and inspect the advancements and improvements made in the equipment involved in production of castings. Tickets will be distributed by the Northeastern Ohio and neighboring chapters.

Host to the 50th Anniversary Convention will be the Association's Northeastern Ohio chapter. The chapter has appointed more than 240 local foundrymen to man its eleven committees that are handling various local arrangements for the meeting.

Chapter President A. C. Denison, Fulton Foundry & Machine Co. Inc., Cleveland, heads the supervisory General Convention Committee, with Henry J. Trenkamp, Ohio Foundry Co., Cleveland, as Vice-Chairman; Gilbert J. Nock, Nock & Sons Co., Cleveland, as Secretary, and F. Ray Fleig, Smith Facing & Supply Co., Cleveland, serving as Treasurer.

Chairmen and Vice-Chairmen, respectively, of the other committees on arrangements are as follows:

Welcoming—George J. Leroux, National Malleable & Steel Castings Co., Cleveland; and Leroy P. Robinson, Werner G. Smith Co., Cleveland.

Transportation—George Walton, Madison Foundry Co., Cleveland; and Joseph Hanks Jr., Taylor & Boggis Foundry Co., Cleveland.

Publicity — Sterling N. Farmer, Sand Products Corp., Cleveland; and Edwin Bremer, *The Foundry*, Cleveland.

Plant Visitation — John Price, Ferro Machine & Foundry Co.,

Cleveland; and Bruce Aiken, Crucible Steel Casting Co., Cleveland.

Banquet—Thomas G. Johnston, Republic Steel Corp., Cleveland; and Arthur J. Tuscany, Foundry Equipment Manufacturers Association, Cleveland.

Finance—F. Ray Fleig, Smith Facing & Supply Co., Cleveland; and Homer Britton, Cleveland Co-Operative Stove Co., Cleveland.

Northeastern Ohio Day—E. M. Follman, Griffin Wheel Co., Cleveland; and Michael G. Thomas, City Foundry Co., Cleveland.

Entertainment of Foreign Visitors —John H. Tressler, Hickman, Williams & Co., Cleveland; and William G. Gude, *The Foundry,* Cleveland.

Arrangements — Frank C. Cech, James G. Goldie and D. C. Courtright, Cleveland Trade School, Cleveland.

Ladies' Entertainment—Mr. and Mrs. Russell F. Lincoln, and, as Co-Chairmen, Mrs. A. C. Denison, Mrs. F. Ray Fleig, Mrs. Gilbert Nock and Miss Olga C. Trenkamp.

Committee Meeting Schedule

A resume of the partial list of committee meetings in Cleveland during Golden Jubilee week follows:

Monday, May 6

Committee on Reclamation and Alloying, Aluminum and Magnesium Division
Committee on Fluidity Testing
Committee on Core Tests, Foundry Sand Research Project
Committee on Sand Castings, Aluminum and Magnesium Division

Tuesday, May 7

Executive Committee and Committee on Specifications for Test Bars, Brass and Bronze Division
Committee on Inspection of Castings
Committee on Sand Shop Operation Course
Committee on Flowability, Foundry Sand Research Project
Committee on Section Size Relationships, Gray Iron Division
Committee on Test Bars, Aluminum and Magnesium Division
Subcommittee on Physical Properties of Steel Foundry Sands at Elevated Temperatures, Foundry Sand Research Project
Committee on Inoculation, Gray Iron Division

Wednesday, May 8

Annual Lecture Course Committee
Subcommittee on Nickel Alloys of Recommended Practice Committee on Sand Castings, Brass and Bronze Division
Committee on Centrifugal Casting, Aluminum and Magnesium Division
Gray Iron Division Committees
Subcommittee on College Foundry Courses, Committee on Cooperation with Engineering Schools
Committee on Cooperation with Engineering Schools
Committee on Recommended Practices on Permanent Mold Castings, Brass and Bronze Division

Thursday, May 9

Committee on Job Evaluation and Time Study
Committee on Recommended Practices for Centrifugal Casting, Brass and Bronze Division
Executive Committee and Committee on Program and Papers, Patternmaking Division
Chemical Analysis Committee
Committee on Green Sand Properties, Foundry Sand Research Project
Subcommittee on Physical Properties of Iron Foundry Molding Materials at Elevated Temperatures, Foundry Sand Research Project
Committee on Foundry Talks to Engineers and Students, Committee on Cooperation with Engineering Schools
Committee on Heat Treatment of Steel Castings, Steel Division
Committee on Mold Surface, Foundry Sand Research Project
Committee on Program and Papers, Steel Division

Friday, May 10

Executive Committee, Steel Division
Executive Committee, Gray Iron Division
Committee on Non-Destructive Testing, Steel Division
Subcommittee on Microstructure of Brass and Bronze Alloys, Brass and Bronze Division

"Perfect Shipping Month," sponsored by a number of transport and traffic groups, will be inaugurated at a dinner in the William Penn Hotel, Pittsburgh, Pa., March 18. A number of distinguished speakers have been invited, and will discuss lowering costs and reducing damage.

Foundry Chemists Plan Convention Luncheon

FIRST NATIONAL meeting of the A.F.A. Committee on Chemical Analysis will take place at a luncheon scheduled for 12 noon, Thursday, May 9, during the A.F.A. 50th Anniversary Foundry Congress and Foundry Show in Cleveland, May 6-10. The meeting place will be announced in the near future.

In view of the current trend toward increased analytical control of foundry processes, the Chemical Analysis committee expects to find a great deal of interest in foundry laboratories among foundrymen at the convention.

Chemists, metallurgists, foundrymen and other interested persons are invited to attend the luncheon; and those planning to do so should send a postcard or letter to that effect to the Committee on Chemical Analysis, American Foundrymen's Association, 222 W. Adams St., Chicago 6.

Functions of the committee include the study and evaluation of analytical methods for foundry laboratory application, as well the sponsoring of articles on chemical analyses and foundry control which are published in the AMERICAN FOUNDRYMAN.

Casting Defects Book in Final Preparation Stage

MEETING AT the A.F.A. National Office in Chicago, February 23, the Committee on Analysis of Casting Defects, Gray Iron Division, devoted the entire day to a careful review of the manuscript for the forthcoming casting defects book which, reports Committee Chairman W. A. Hambley, Allis-Chalmers Mfg. Co., Milwaukee, will shortly be ready for publication.

Mimeograph copies of the manuscript are in preparation for the final editing by committee members.

Included in the book will be illustrations of casting defects and discussion of their causes, together with recommendations for improvements in procedures through use of the information contained.

Since these data are subject to progressive additions, consideration has been given to publishing the volume in loose-leaf form.

ELIMINATING CASTINGS DEFECTS

Tracing causes of casting defects — corrective and preventive measures promptly set up — aid the foundryman to perfect his product. Presented before the Detroit Chapter of A. F. A., October 18, 1945.

Pierce Boutin
Pontiac Motor Co.
Pontiac, Mich.

IN PERFORMING the job of tracing down the causes of casting defects, the foundryman must bring into play many things. His first reaction upon observing a defect probably is to classify it and then ask himself this question: "Have I seen this one before, and if so, what caused it?"

If he is able to remember a previous occurrence of that defect, and the cause of it, his next action is to mutter something like this: "I wish those people out there would do things the way they were told." He then proceeds to the spot and with emphasis, diluted with diplomacy, proceeds to point out the cause of the trouble and stay around to watch its correction. His next move is not so constructive, probably consisting of a brisk walk to the superintendent's office and a conversation which begins something like this: "Well, I licked that one—etc."

Element of Time

If all cases could be solved in this way, foundrymen would not change places of business so often, and the profits would be greater. But a large part of the troubleshooter's time is spent in solving problems that to his memory did not happen that way before, or had cleared up before the cause was discovered, which added much to the happiness but little to the knowledge of those concerned.

Memory is the tool that solves problems in some cases. Reasoning must be employed after memory falls short, and to build up a background to use in our reasoning we must learn all we can of the behavior of the different materials in use when subjected to the treatment they must receive in the making of castings.

All troubles clear up in time. We always are fighting against time. Therefore, much of this paper is devoted to a certain time in the production of a casting. That is, the short time elapsing from the start of pouring to complete solidification of the casting. Of course, the time preceding this is very important, and the time that starts after solidification, and ends when the casting and the car it has serviced reaches the junk yard is important, also.

Basic Causes of Defects

Faulty castings result from the use of metal which has varied outside the limits of desirable analysis, or which is poured too cold or too hot or contains impurities which travel into the casting. Dirt inclusions may be caused by careless molding and coresetting practice. Blows and misruns can be caused by the misuse of oil in cores or water in molding sand, by improper venting, improper gating, cold iron or lack of sufficient thickness of metal, and many other factors.

Then starting at the period after solidification, cracks may be caused by rough handling, or by too rapid cooling. Hard spots may be caused by lack of attention to grinding wheels. Dimensional defects may be caused both before and after the period mentioned by improper pattern mounting, improper setting of cores, too light chaplets, sloppy flask bushings and improper clamping of the flasks, or by unclamping too soon. Also, in the casting, the improper grinding of locating pads or overgrinding generally results in dimensional defects.

The period between the start of pouring, and through final solidification, rates very high in importance, and a good share of this paper is devoted to it because it should receive more attention from those employed in research, for during this period occur most of the mysterious happenings which baffle us.

Metal Flow

As an example, it is everyday knowledge in the foundry that two molds may be made from the same batch of sand, the cores in each mold made from the same sand and all properly vented, both molds poured from the same ladle of iron, and one casting is good and the other defective and showing considerable metal disturbance.

When liquid metal enters the sprue it travels down to the next part of the pouring system, probably a horizontal runner, which has a reduced flow area or "choke." This "choke" permits the sprue to fill, reducing the downward velocity and floating impurities back to the highest metal level.

Each successive part of the pouring system is thus reduced in flow area, or choked smaller than the part which feeds it to prevent the progression of impurities which were present in the metal or picked up on the way to the mold proper.

The amount of total choke between sprue and gates should not be so great as to cause excessive gate pressure or "squirt." This might

lead to the cutting of cores or molds, or splashing upon the higher core levels and causing cold spots. Also, insufficient difference in the flow areas between sprue and gates results in a sluggish flow of metal through the gates and encourages the formation of blows and cold shorts.

The introduction of metal into the mold starts a series of changes which, by their type, magnitude, and timing, influence the quality of the final casting. One of these changes is the rapid increase in the surface temperature of cores and mold, as contrasted with the relatively slow temperature rise in the secondary layers back of these surfaces. This causes expansion differences and shear stresses that lead to scabbing, and should this expansion have considerable depth, and still lead to rupture, the result is termed a buckle.

Gas Pressure

Another effect of the introduction of heat into the mold is to start the evolution of gas from cores and molding sand, which builds up pressure in the mold, forcing gas out through the molding sand and mold vents. The gas produced in the cores, at this stage in the pouring, moves mainly outward into the mold and only partially through the core vents.

As the metal level rises in the mold it gradually covers the surface of the cores until finally all core gas must move out through the core vents. Or should the relief through the vents be inadequate, back pressure is built up, forcing gas back through the metal, causing a boiling action and blows, and if this back pressure prevents the metal from completely joining over the cores the result is a misrun.

At the stage where the metal is about to cover the top of a core, maximum buoyancy is applied to the core and the strain against coreprints and chaplets reaches a maximum.

At the instant metal starts flowing into a mold it hastens in the direction of final solidification. Metal skins are formed against cores and molding sand surfaces, the metal flowing between these skins, and particularly in areas not in front of the gates, this liquid metal moves with an ever increasing viscosity.

This skin-forming tendency is most important for it keeps the sand from being continually attacked by fresh metal and promotes good casting finish. On the other side of the ledger, these skins discourage flow, especially in thin sections, and prohibit the removal of gas out of the metal through the molding sand.

As the metal level reaches the top of the mold the effective head pres-

Baked cores being handled from the rack. Proper coremaking and setting practices are important factors of quality casting production.

sure from the pouring system is suddenly added to the pressure caused by the weight of metal in the mold, to produce the maximum strain against mold surfaces. This is the instant that most sags or swells are started.

With the mold filled with metal which varies all the way from liquid, to semi-liquid, to solid, the casting progresses on to complete solidification. At this stage all mold vents are useless and any gas or other impurities present in the metal at this time are there to stay.

As the metal continues on to complete solidification there is a shifting of the liquid from the more fluid to the less fluid sections of the casting as the result of normal shrinkage. Shrink holes, tears, and dendritic areas occur when this exchange of metal is restrained or prohibited.

The final movement of metal should be through the gates and feeding the areas directly in front of the gates. During this period, any swelling of the mold or outward movement of a core print, or bleeding through a core print or into a vent may cause a recession of the metal resembling a shrink or even a blow.

This attempt to visualize changes that take place in the shaping of a casting is not a complete picture. Many facts have been omitted mainly because the author does not know them. But the troubleshooter should attempt continually to understand the various changes in the order of occurrences, and make them part of his reasoning equipment when tracing a defect back to its source.

From the standpoint of profit and loss, however, it is not enough merely to correct trouble. The real benefits are derived from the prevention of trouble. Therefore, once the cause of a defect is found all steps should be taken for a "follow through" to prevent the reoccurrence of that defect.

Gating systems should be checked regularly for dimension changes due to core box or pattern wear. Core venting can be checked by time spent in the coreroom, and in the study of the gassing of molds, and in breaking up scrap core assemblies.

Core-setting practice should be observed often for rough handling or improper positioning of cores. The amount of touch on prints and chaplets should be checked often by dusting the assembled cores, and then coping and removing the cope. Castings studied in the shakeout will show vent metal or bleeding spots.

Castings studied before cleaning tell a story by the amount and thickness of fins, the amount and position of shiny spots, and the relative coloring of sand is related to the direction of metal flow. The presence of "burnt-in" sand indicates agitation, or possibly means that the metal had contacted the sand and then receded, destroying the mold skin, and then followed with re-contact and penetration.

The cleaned casting may reveal evidence of sloppy flask or pattern bushings, excessive chaplet pressure, and if broken or sawed up can show section thickness, excessive finning, or early collapse of cores.

NATIONAL OFFICE
Announces Three Additions to Staff

IN ORDER TO COMPLETE arrangements for staging the 50th Anniversary Convention and Exhibit May 6-10, your Association has made the following staff additions:

S. C. Massari

S. C. MASSARI, who has served with the Chicago Ordnance District as a Major and Lt. Col. in charge of Tank-Automotive Production, has been assigned the task of carrying through the program of Technical Sessions, in view of the sudden illness of N. F. Hindle, Director, A.F.A. Technical Development Program. Mr. Massari is well known in the field of ferrous metallurgy and for over 16 years prior to his entering military service was chief metallurgist in charge of research, Association of Manufacturers of Chilled Car Wheels, Chicago.

Author of a well-known book dealing with chilled iron, Sil Massari has long been active in A.F.A. affairs, serving on technical committees, author of convention papers and speaker before A.F.A. chapters. He is a member of A.F.A., ASM and ASTM. Mr. Massari's services have been secured under a temporary arrangement extending through the convention period.

J. P. Mullen

The task of properly publicizing the Golden Jubilee Convention and Exhibit has been turned over to JOHN P. MULLEN, formerly educa-

(Concluded on Page 68)

J. P. Mullen

S. C. Massari

J. E. Foster

VOCATIONAL SCHOOLS TRAIN

FUTURE FOUNDRYMEN

AT A TIME WHEN personnel of all types is sorely needed, foundrymen may well consider the educational facilities of vocational and trade schools. Such schools can be expected to provide trade training and related instruction for standard apprentice courses, short term courses for specialists, advanced courses and refresher courses; some also offer pre-apprentice training.

Cooperation between A.F.A. chapters and vocational schools was outlined in an educational article in the January AMERICAN FOUNDRYMAN. This discussion concerns the functions of vocational schools and instances in which chapter aid and cooperation have been successful.

Opportunities for Trained Men

According to U.S. Department of Labor literature, employment in foundries in the next two years will approach that of the peak war year. Later there will be a moderate gradual decline, but foundry employment will remain high. From the long range point of view, job opportunities are good in the casting industry because special training is required. The future for skilled workers is considered better than average by job counselors. These facts emphasize the significance of training and the desirability of close cooperation by A.F.A. chapters with vocational schools.

The primary function of vocational schools is to train young men to enter the foundry industry at a journeyman level. As these young men acquire industrial experience, they become available to foundries as skilled workmen, and provide a pool from which supervisors can be drawn. In some instances trade training and related instruction are both given at the school.

Background and Curriculum

Typical vocational school aims and suggested requirements for apprentices are those given by H. W. Hershey, instructor at Revere Trade School, Rochester, New York. These illustrate the entrance requirements to vocational training and the caliber of the finished student.

Courses in foundry practice and patternmaking at this school are designed to fill the needs of students planning to go into the trade or expecting to enter engineering college.

Pupils expecting to follow the course in foundry practice must be at least first year high school students, physically fit and willing to work. They must possess or develop responsibility. Those entering the patternmaking course should be at least first year high school students, able to work with fractions and decimals and with some knowledge of geometry.

Trade training in the school frequently is necessary because jobs do not always supply the requirements for a fully competent worker. Some plants offer enough variety in work so that the school need furnish only the related training.

In any event, apprentices should receive some instruction in allied trades, mathematics, blueprint reading, drafting, sketching, chemistry, physics and elementary metallurgy. In areas where emphasis is on mechanized production, some knowledge of plant layout, work routing and materials handling might be necessary.

Vocational schools fill a special need in some areas by offering continuation courses. These courses for graduate apprentices may be either refresher courses or advanced courses dealing with new phases of foundry practice.

Refresher courses are helpful in the case of veterans whose experience as journeymen was interrupted by the war. Many servicemen feel the need for a review of fundamentals before tackling work of journeyman caliber. Such instruction is also valuable for men whose skill has deteriorated due to a long period of unemployment.

Advanced courses keep skilled workers up to date in new foundry technique and mechanical developments. The value of continuation courses which could be offered by local vocational schools should not be overlooked by A.F.A. chapters.

Specialist Training Offered

Similar to refresher courses, but at a lower level, are special courses designed to train workmen in a limited phase of foundry practice. Graduates of these courses are expected to know how to perform a specific task. Men with such limited background may be handicapped by inability to move from one job to another without additional special training.

The schools can provide the trade training and limited related instruction required to make an unskilled individual capable of performing a single task efficiently. Special courses of this type, such as were included

in the E.S.M.W.T. program, were offered during the war. Specialist training can be valuable in developing workmen to fill immediate needs for foundry personnel.

Vocational schools should be considered when planning apprentice programs or on-the-job training for veterans. Most registered apprenticeship programs meet the requirements for veteran training under the Vocational Rehabilitation Act and the GI Bill of Rights. Both laws permit on-the-job training for specialists which may be supplemented by instruction in an approved school.

Some vocational schools offer courses to regular high school students, thus functioning also as technical high schools. In some A.F.A. chapter areas both types of schools, operating in separate buildings and with different teachers, will be found. The technical high schools should not be forgotten.

Good relations between such institutions and A.F.A. chapters are profitable from a long range point of view.

Technical High Schools

Students in technical high schools and schools receiving aid under the Smith-Hughes act usually have not chosen a vocation. Their choice will be influenced strongly by survey courses in various trades which are part of the school curriculum. Whether they decide to enter the foundry industry or not, students have a better appreciation of foundry products and processes if they receive a well-balanced survey course taught by an enthusiastic instructor.

A poorly organized foundry course in a school improperly equipped to teach modern foundry techniques cannot be expected to impress students only casually interested in the casting process. Most of these students will not go into the foundry industry, but will use castings directly or indirectly. They should carry with them a favorable impression of castings and foundry processes.

Primarily a responsibility of A.F.A. chapters, vocational schools may be cultivated in a variety of ways. Remembering that instructors are limited by school administration policies, chapters should not confine contact to instructors alone. Include, if possible, a member of the school board or other administrative official on the chapter committee which deals with the vocational school problems.

Foundry instructors and pattern instructors of the schools should be members of the local A.F.A. chapter, and should be encouraged to participate actively in chapter affairs. Special membership dues at low rates are offered to vocational instructors by the A.F.A.

Instructors Have Important Role

Participation of educators in A.F.A. National Programs should be strongly encouraged. Some of the most enthusiastic workers on A.F.A. national committees for apprentice training are vocational school teachers. These men are recognized leaders in their field and take an active part in promoting apprentice training, the A.F.A. National Apprentice Contest and have contributed heavily to literature on training methods.

Vocational schools gladly adjust their curricula to the needs of the community's industry. One form of chapter cooperation is to aid the schools in maintaining an up-to-date course of study and training. Teaching aids such as castings and patterns, technical books and periodicals, films, posters and exhibits are always welcomed by an instructor.

One A.F.A. chapter recently began the collection of extra copies of trade journals and technical periodicals which accumulate in offices and laboratories. These publications will be distributed to educational institutions in the chapter area. One A.F.A. member plant purchased soundstrips which it loans to schools in the area.

Training Films

The U.S. Office of Education has produced a number of excellent foundry and patternmaking training films in the last few years. Purchase of these films is being considered by several chapters which plan to loan them to schools and use them in local plants. The A.F.A. National Office has compiled a list of available films produced by foundries, the U.S. Bureau of Mines, foundry equipment manufacturers and foundry suppliers. This list is available on request.

Occasionally speakers from the chapter can substitute for an instructor in order to deliver talks on foundry topics in which they are particularly well versed. Inspection trips to modern foundries should be arranged to allow students to develop an appreciation for the industrial side of foundry practice. An inspection trip is helpful in building up lagging enthusiasm because it shows apprentices how training fits them for a job in an industry of endless opportunities.

Vocational school students should be invited and encouraged to attend chapter meetings. Some chapters provide a working arrangement whereby students pass out programs, distribute and collect chapter member identification badges, and participate in all meeting night activities at no expense to the student.

Other chapters designate one meeting a year as Apprentice Night and devote the entire evening's program to apprentices, apprentice instructors and supervisors, and vocational schools.

During vacation periods some vocational school instructors may be offered jobs in local foundry or pattern shops. This means of industrial cooperation is of direct benefit to the trade teacher and the plant that hires him. From a broader standpoint, the teacher thus acquires skill in the latest foundry techniques, which lends authority to his lectures and training sessions.

Questionnaire Aids Chapters

Chapters of A.F.A. wishing to study local vocational school facilities will find the questions below of value. This questionnaire was distributed by the Baltimore Association of Commerce to aid in reviewing trade school problems in the light of industrial needs.

1. What are the probable employment needs of your industry during the next five years?

2. If it is not possible to give actual figures, can you make an estimate of the present employment total, and prepare some kind of statement as to postwar prospects?

3. Judging from boys and girls you have employed in the past, what are your opinions of the job that local schools are doing to prepare them for your industry?

4. From your personal observations in touring local schools, what are your opinions of the machinery, equipment and technical processes used by the schools in trade preparation for your industry?

5. What opinions have you formed of the methods used by the schools

in teaching trades in which you are interested? Are the subjects covered adequately, within the limits of what the schools can do, and is emphasis put on the right points? Is the approach practical? If you can suggest improvements, what are they?

6. What opinion have you formed of the teaching ability and technical qualifications of school instructors you have seen? Does the teaching staff have your confidence? Do the instructors impress you as having a practical grasp of subjects they are teaching?

7. Aside from the vocational type of training given in the schools, do you think the instruction the schools are giving in mathematics, English and other general subjects is adequate? What suggestions do you have for changes and improvements?

8. In preparing young people for your industry, would you prefer that the schools put more emphasis on general academic subjects, more on shop type training, or more on related classroom subjects of a vocational nature, such as mechanical drawing, blueprint reading, shop mathematics, etc.?

9. What new types of courses would you suggest the schools offer?

10. Some school officials are proposing a vocational-technical type of training. This is expected to give students instruction at a level higher than vocational school training.

(a) Is your industry interested in vocational-technical training?

(b) Can you enumerate some of the jobs in your industry for which vocational-technical training would be desirable?

(c) Can you estimate the number of graduates in each category listed which your industry might absorb?

11. Try to indicate the approximate number of individuals your industry might absorb directly from the schools. If you are unwilling to hazard a guess as to numbers, could you give some indication by the use of percentages? Please use the following as a guide:

(a) Number of boys and girls with only elementary school education and no trade training at all.

(b) Number with only elementary school education and shop type trade preparation.

(c) Number with high school education, and only incidental vocational subjects.

(d) Number with elementary school education, plus vocational training in the high school years.

(e) Number with a vocational-technical type of training, equivalent to a full high school education plus specialized technical training.

12. To what extent do you think your industry might continue, during the postwar period, the use of women for mechanical and industrial work formerly performed by men? Would you encourage schools to prepare women for jobs of this kind?

13. What suggestions would you make to bring your industry and the schools into a closer contact and working relationship? Some of the possibilities for your consideration are presented in the following:

(a) Loan of instructors to schools by industry.

(b) Loan or gift of equipment and materials.

(c) Summer employment in industry for vocational teachers.

(d) A systematic program under which school pupils visit industry and observe productive operations in the trade for which they are preparing.

(e) A cooperative program under which boys and girls spend alternate periods working in industry and studying in the schools.

(f) A school employee to act as liaison officer or coordinator between your industry and the schools.

(g) An industry committee to work closely with the schools.

Start Room Assignments For May Convention

THE MONUMENTAL task of assigning hotel rooms for the 50th Anniversary Foundry Congress and Foundry Show to be held in Cleveland May 6-10 has begun, with a flood of hotel applications indicating a record attendance.

As previously announced, the Official A.F.A. Housing Bureau is making all hotel room assignments for Convention attendance this year; and Cleveland hotels are cooperating in splendid fashion to assure accommodations for those attending.

All applicants may be assured that every consideration will be given individual desires for accommodations, insofar as is possible. A.F.A. members and 1946 exhibitors will, of course, receive first consideration, along with the session chairmen, co-chairmen, authors of papers, and others whose activities are essential to conduct of the Golden Jubilee meeting.

Please Be Patient!

Your Association has only one request to make of all who are seeking rooms for the Cleveland Convention, that is—*Please Be Patient.* Hotel applications are being processed, and room assignments made, as rapidly as requests can be handled, and applicants will be notified thereof promptly. Some delay is unavoidable, but every effort is being made to "clear the decks" for the A.F.A. Congress well in advance of the opening day of the meeting, May 6.

Members who have not yet made application for hotel rooms are *urgently requested to do so immediately.* Hotel applications should *not* be sent to A.F.A. headquarters in Chicago—but should be mailed directly to A.F.A. Housing Bureau, Terminal Tower, Cleveland 13. Sending applications direct to Cleveland will avoid unnecessary delay in their handling.

Committee To Carry Out Brass and Bronze Study

THE A.F.A. COMMITTEE on Microstructure of Brass and Bronze Alloys met at the Statler Hotel in Cleveland, February 5. Under the direction of Chairman Blake M. Loring, Naval Research Laboratory, Washington, D. C., the committee discussed the effect of foundry practice on microstructure.

The committee tentatively decided to cast copper-base alloys in various section sizes under different foundry conditions. Microstructure, macrostructure, fracture and mechanical properties of the specimens will be studied. The project may be carried on as a joint effort by selected foundries and several engineering colleges.

INSULATING PADS AND RISER SLEEVES FOR BRONZE CASTINGS

H. F. Taylor and
W. C. Wick
Steel Castings Section
Naval Research Laboratory
Washington, D. C.

NON-FERROUS FOUNDRY practices have been shown, particularly by wartime production experiences, to be in need of an extensive investigation. Increased emphasis upon inspection and the development of improved and new inspection tools focused attention upon serious shortcomings in castings. More strenuous performance requirements caused an increased number of service failures, and often the replacement casting proved to be little or no better than the original.

Ever-increasing shop production demands and shortage of manpower may have caused a relaxation of otherwise adequate foundry practices in some shops, but even prior to the war the situation pointed to the need for improvement in non-ferrous foundry practices. By far the greater number of service failures have been in castings operated under pressure. The reasons given for failure have been many and varied, and often depend more upon the individual interpretation than upon any factual evidence.

Sometimes the foundryman blames gassy metal caused by improper melting or wet molds, sometimes impurities or improper composition are blamed, and occasionally shrinkage caused by inadequate feeding is determined to be the trouble. Any one, or all, of these conditions may cause bad castings, but it seems probable that the greatest offender is shrinkage in one or another of its many manifestations.

Research upon the gating and risering of steel castings indicates definite limitations upon the ability of risers to feed castings adequately unless great care is taken to position and proportion gates and risers properly. The type of defect most apt to cause leakage of steel castings under pressure probably is shrinkage, because of the interconnected, filamentary voids.

Gas porosity, unless sufficiently extensive to be readily recognized as such, usually in the form of rounded, disconnected voids, would not necessarily cause leakage. Sections of non-ferrous castings which have failed indicate lack of internal soundness which, more often than not, resemble similar sections taken from steel castings which have been made without proper attention to known laws of solidification.

New foundry techniques developed at the Naval Research Laboratory, Office of Research and inventions for production of sound non-ferrous castings, serve to emphasize dependence of good foundry practice upon proper gating and risering. Insulating pads and riser sleeves placed respectively on their sections and around risers keep the metal in these regions hot and molten until the casting has become solid. Applications of the method show the importance of controlled directional solidification. The opinions expressed are those of the authors and do not necessarily reflect the opinions of the Navy Department.

Further evidence in support of the theory that shrinkage in one form or another, if not repaired by welding, is responsible for service failures in steel castings is a survey made by the Westinghouse Electric Co. in which shrinkage was definitely branded as the worst problem. This condition exists in spite of all the research which has been done on this problem in steel castings. It is reasonable to suppose that a similar condition may exist in non-ferrous castings, upon which relatively little fundamental research has been done.

Studies at the Naval Research Laboratory upon the effect of atmospheric pressure as a potent factor in making sound castings and, oddly enough, as an even more potent force in causing bad castings, have led to a realization of the many ways in which gating and risering can affect the end-product of the foundry. For example, serious blows at internal corners of castings, exaggerated areas of low density, and so-called "pulls," "draws," or "dishing" of castings are results of atmospheric pressure acting upon an improperly risered casting.

Certain surface defects, particularly on cope surfaces, discontinuities which appear to be tears caused by hard molds, small cavities beneath vents and in front of ingates, and many other defects normally not associated with shrinkage, more often than not are a direct result of improper gating and risering practices. A natural tendency exists on the part of non-ferrous foundrymen to use as few gates and risers on a casting as possible because their re-

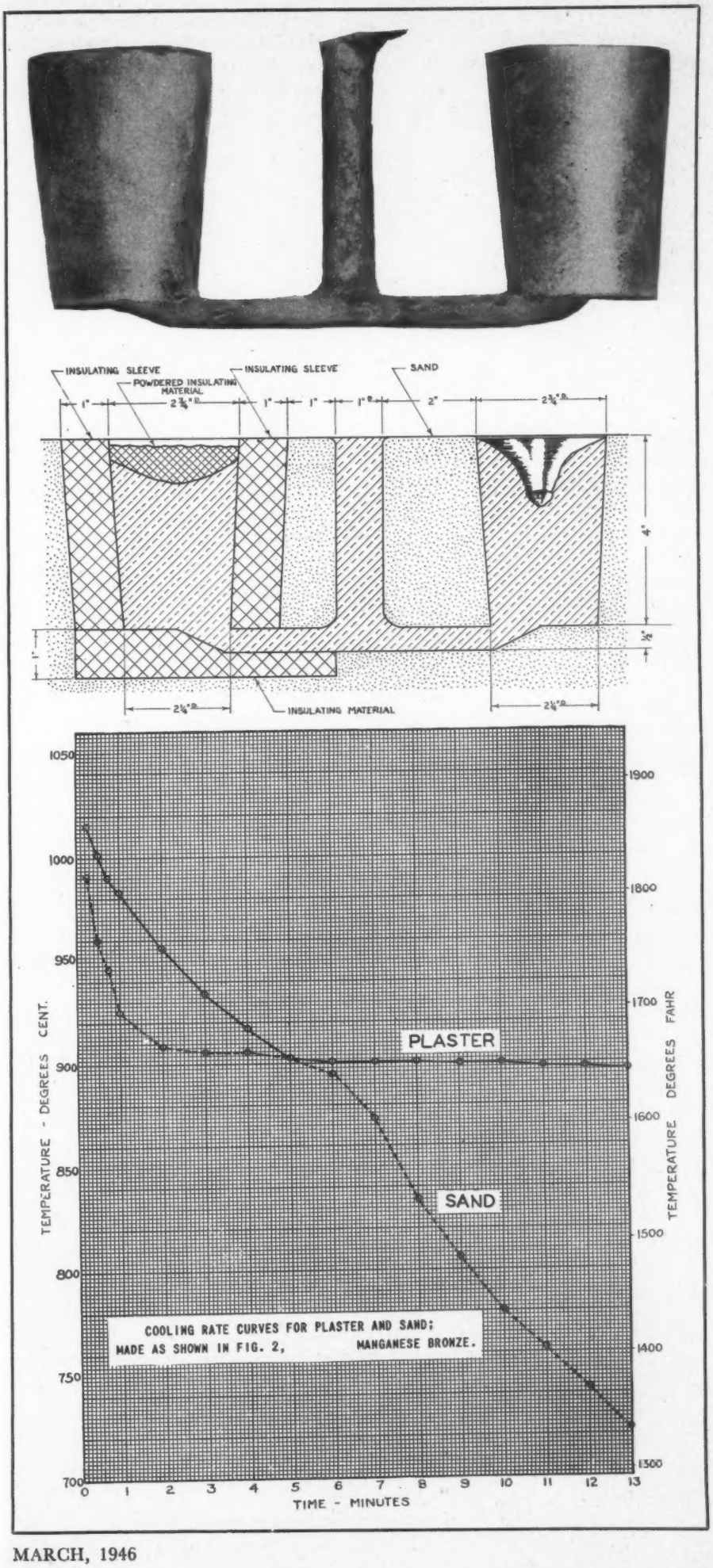


Fig. 1 (left)—Test ingots used to determine relative rates of solidification of manganese bronze in green sand and in gypsum; pouring temperature 1025° C. (1880° F.).

moval from the casting is a serious problem.

It is not possible to use torches for this purpose, as can be done with steel castings, and their removal by saw or cold chisel is laborious and expensive. A balance must be made between the selling price of the product and the amount of work that can be done in the machine shop in order to meet competition.

This factor, rather than good engineering, too often determines the size, number, location, and design of risers, and inadvertently affects adversely the soundness of the casting. The foregoing factors indicate the need for fundamental information on the solidification of nonferrous castings.

General Considerations

In 1928 a project was authorized at the Naval Research Laboratory by the Navy Department to study the fundamental defects in steel castings. Since that time a great deal of practical information has been compiled on the solidification characteristics, gating and risering, and general foundry practices used for steel and the principles are quite generally appreciated and used. Much of the information should apply to other metals but, unfortunately, relatively little effort has been made to determine if this is the case.

The principles of and need for controlled directional solidification in castings have been recognized for many years by steel foundrymen, and numerous articles have been published on the subject [1, 2, 3, 4]. The theory is simple but often difficult to apply in practice.

It means only that in order to obtain maximum benefit from feed heads and the soundest possible casting it is necessary to have the coldest metal within the feeding range of a given feeder at a point farthest

Fig. 2 (center and bottom)—Sketch showing molding technique used in solidification test of casting shown in Fig. 1 and the location of the thermocouples (T). Cooling rate curves for manganese bronze casting made as shown in sketch.

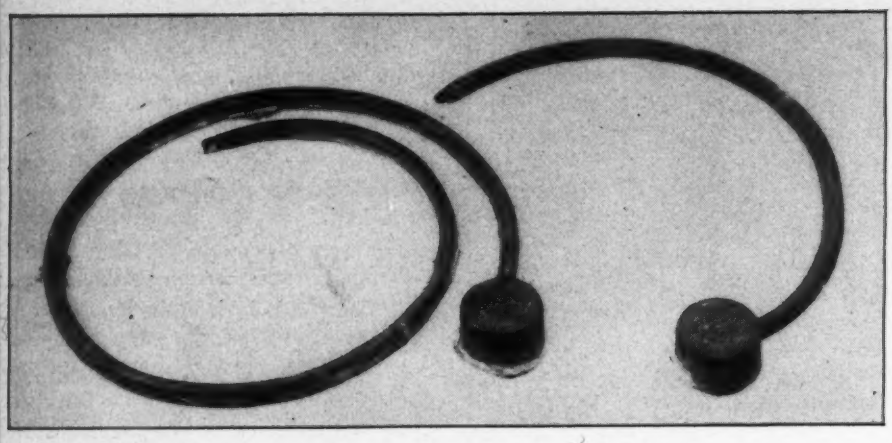


Fig. 3—Fluidity test spirals of ingot copper; pouring temperature 1175° C. (2150° F.). Left—plaster, 34 in. Right—green sand, 15 in.

from the riser, and that the metal be progressively hotter toward the riser at all times during solidification. The normal way to obtain proper directional solidification in a casting is to taper sections slightly toward the riser, being sure that the taper is progressive in all respects and that intermediate thin sections are not present which would solidify prematurely and choke off feeding.

It is not possible to feed heavy sections through light sections, and chills or auxiliary feed heads must be provided whenever the casting is so designed as to limit the feeding range of the main risers. In other words, the "ingot principle" must be used for each and every riser independently, and an adequate number of risers must be provided to feed the solidifying casting.

This principle should be as important in the manufacture of non-ferrous castings as it is for steel, and considerable evidence is available to indicate that such is the case.

Influence of Atmospheric Pressure

Atmospheric pressure as a factor in foundry techniques has been found to have marked influence on the integrity of steel castings, and principles governing its behavior have been carefully determined. It is interesting that, with a proper understanding of the manner in which atmospheric pressure operates upon a body of solidifying metal, sound castings can be produced, while without this knowledge unsound castings often result.

It is surprising to note that little or no work has been published, and apparently little notice given this important principle by non-ferrous foundrymen, although the influence can be even more far-reaching than is the case in steel casting.

An appreciation of the manner in which atmospheric pressure exerts a profound influence in foundry practice can be gained by a brief resume of everyday principles of physics. It is well known that atmospheric pressure acts on all objects to which it has access with a force equal to approximately 14.7 psi.

This is a force capable of causing vessels with structurally weak walls to collapse when the pressure within them has been reduced to near vacuum levels, and in the mercury barometer to force mercury to a height of about 30 in. under similar conditions. What is more important to the problem at hand, it is the force which often determines whether sound or unsound castings will be made.

Any casting, regardless of size, shape, or contour can be used to illustrate the point. Atmospheric pressure acts equally on all parts of the casting, and it has been carefully determined that a sand mold is sufficiently permeable to permit this. As the casting solidifies and the metal contracts in volume a tendency for

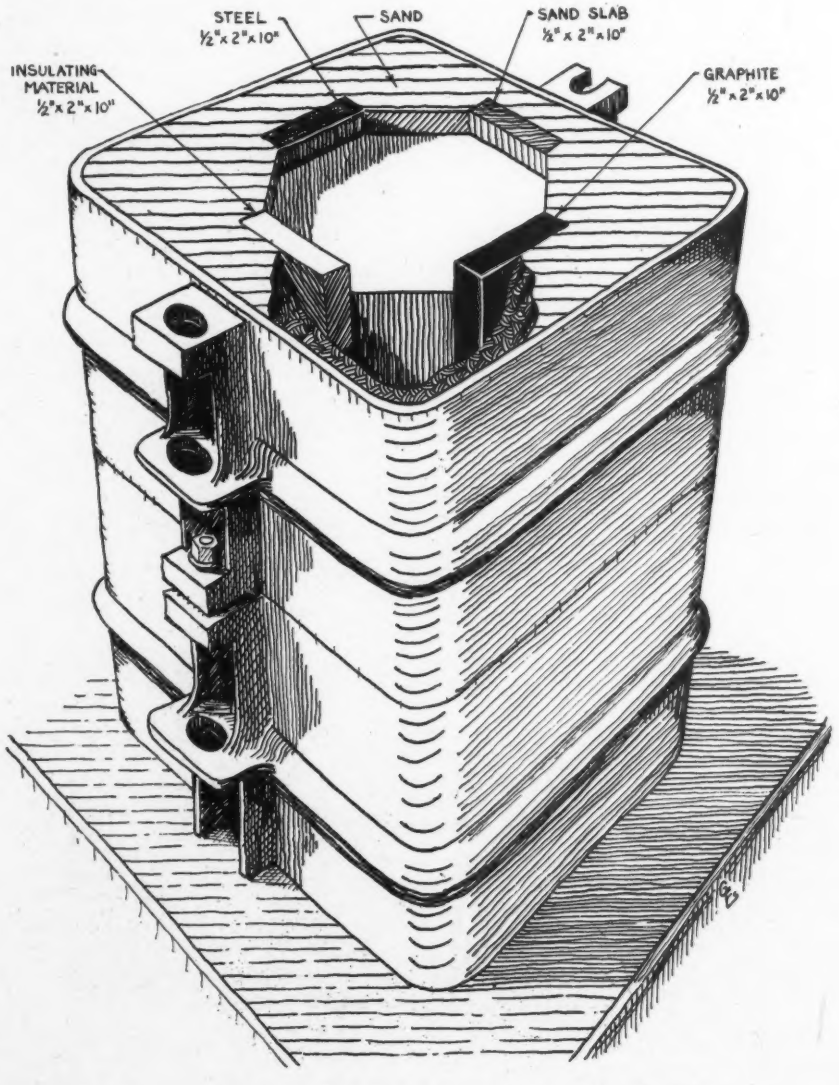
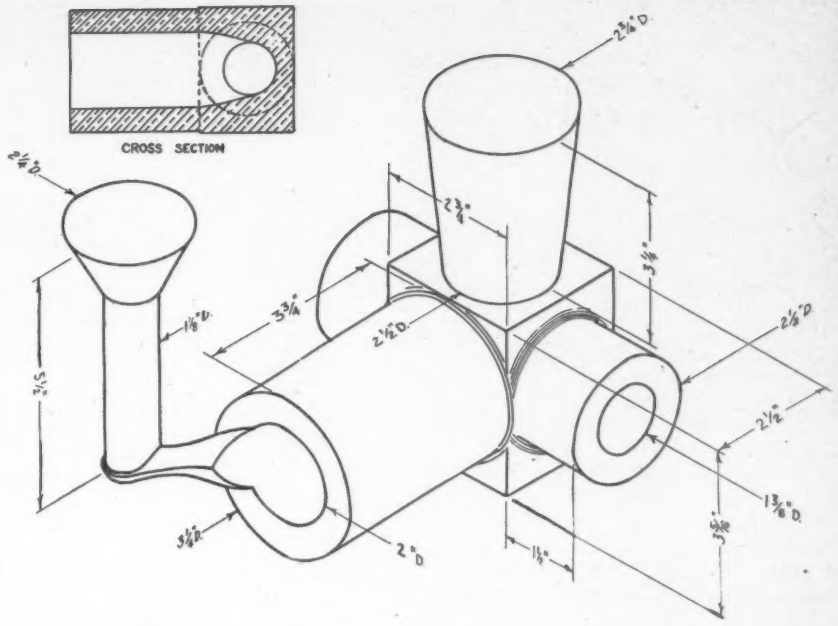


Fig. 4—Sketch of test mold for casting shown in Fig. 5.

Fig. 7 (right)—Sketch of hollow tee casting showing dimensions and cross section.



a partial vacuum to form within the casting exists.

If liquid contact is made at all times with the riser and progressive solidification maintained, the tendency for a vacuum to form will be offset by the liquid metal which moves in to accommodate the shrinkage. However, if for some reason feeding is not adequate a shrinkage cavity will form, a partial vacuum will be created, and a difference in pressure between the inside and outside of the casting will exist.

The magnitude of this difference will depend upon the amount of unfed shrinkage and, whenever it becomes greater than the strength of the solidified skin of metal around the casting, the walls will collapse or puncture at a weak spot to relieve this condition. Castings with extensive flat sections such as plates or large flanges on valves and fittings, which are difficult to riser adequately, are especially prone to "dishing," while castings with internal corners usually puncture through at the hot spot.

It has become general knowledge that if risers are to function properly they must be kept open to the atmosphere in order for this added pressure to aid in feeding. This is accomplished in ferrous castings by use of pipe eliminator compounds to cover open risers, or by the use of a core of some suitable material cast into the cavity of blind risers.

Fig. 5—Section from center of manganese bronze casting; bled after 5 min.; poured at 990° C. (1810° F.).

Non-ferrous foundrymen generally have not taken precautions to insure that the risers remain open to the atmosphere at all times. Often sand is sprinkled on open risers for insulation, a practice which does not appear desirable because of the high specific heat of sand which causes it to absorb heat rather than to insulate, and which causes the riser to freeze prematurely. If risers are not kept open feeding may be materially reduced and atmospheric pressure may gain entry to the casting at some other point.

This brief treatment of a really extensive subject should suffice to indicate that a thorough knowledge of atmospheric pressure, as it applies in the foundry, is essential to the making of good castings, either ferrous or non-ferrous. A paper by Taylor and Rominski[5] entitled "Atmospheric Pressure and the Steel Casting" is a comprehensive treatment of the subject as it applies to steel, and no attempt will be made here to discuss the development in detail since fundamental principles are therein clearly covered.

Attempts to make sound shop castings from copper-base alloys at the Naval Research Laboratory indicated the need for even greater attention to gating and risering than was necessary for steel castings. Risers often have to be larger and more numerous than for steel and,

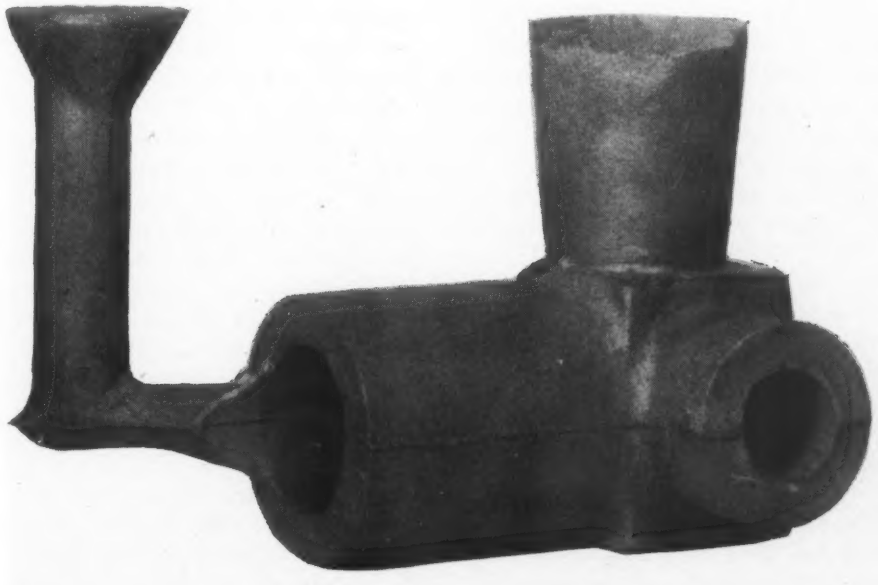


Fig. 6—Hollow tee casting used for testing insulated riser sleeves and insulating pads.

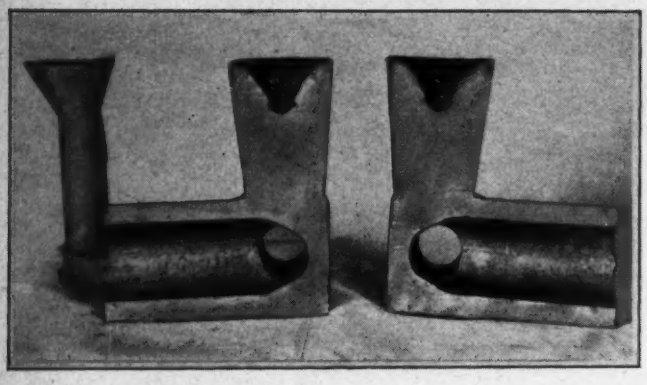


Fig. 8—Hollow tee casting made entirely in a sand mold. Note shrinkage. Manganese bronze; pouring temperature 1000° C. (1830° F.).

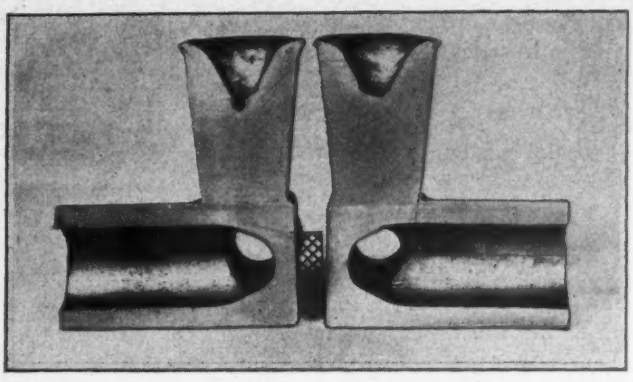


Fig. 9—Hollow tee casting made in sand with an insulating pad placed as shown. No shrinkage present. Manganese bronze; poured at 1000° C. (1830° F.).

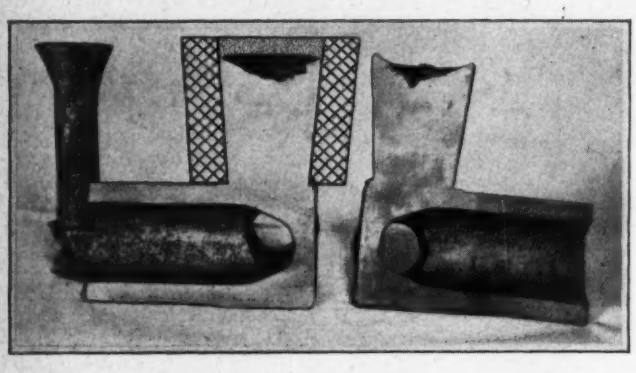


Fig. 10—Hollow tee casting made in sand with an insulated riser as shown; no insulating pad; insulating powder used on top of riser; small amount of shrinkage present; manganese bronze; pouring temperature 1000° C. (1830° F.).

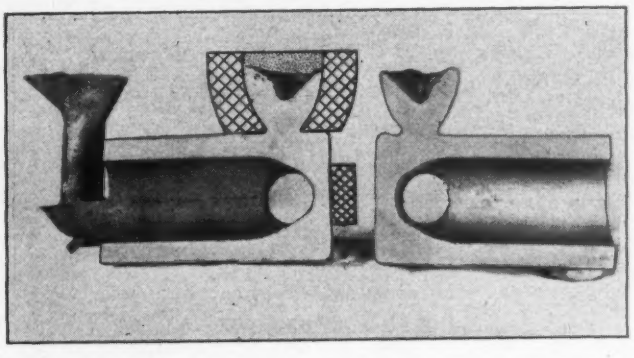


Fig. 11—Hollow tee casting made in sand with pad and riser insulation and insulating powder on top of riser; manganese bronze; pouring temperature 1000° C. (1830° F.).

in general, the temperature gradients within the casting must be more carefully controlled.

Although tin bronzes show markedly less shrinkage, as manifested by riser cavities, than does manganese bronze, it was found that gating and risering for a sound casting in tin bronze was even more difficult than for a casting in manganese bronze.

In order to combat the interdendritic type of shrinkage characteristic of tin bronze, risers have to be very large, and temperature gradients carefully controlled by gating into or through risers as much as possible so that the metal in the riser is kept molten and molten metal contact is maintained with all solidifying portions of the casting until they are completely solid.

In spite of this it is general practice to gate tin-bronze castings into thin sections away from risers and to use few and small risers as compared to those used for similar manganese-bronze castings. This is due to the fact that such a practice distributes shrinkage uniformly and it is not readily noticeable upon casual examination. The use of risers which seem large to foundrymen, and yet are really not large enough for their intended purpose, serves only to localize shrinkage underneath them, shrinkage which can be readily found.

Gating under or through inadequate risers aggravates the condition. However, adequate risers do give sound castings, even in tin bronzes, particularly when temperature gradients are favored by gating through them, and it is not possible to make perfectly sound castings by circumventing this principle. The demand upon risers can be lessened and castings made very sound by an extensive use of chills, a practice which is rapidly gaining favor.

For many years attempts have been made to develop a suitable material from which to make insulating pads and riser sleeves for steel castings as an aid in promoting proper temperature gradients within a solidifying casting. This is common practice for ingot making in which sand is an effective insulator relative to the metal of the ingot mold.

However, no suitable material has yet been found for steel castings, and the closest approach to effective riser insulation is the use of powdered compounds placed on the surface of the metal in the riser to decrease radiation of heat and to insure against premature solidification.

Except as a means of keeping the risers open to the atmosphere, riser compounds are relatively ineffectual as their influence does not extend to the base of the riser where insulation is most needed in order to prevent early solidification at neck.

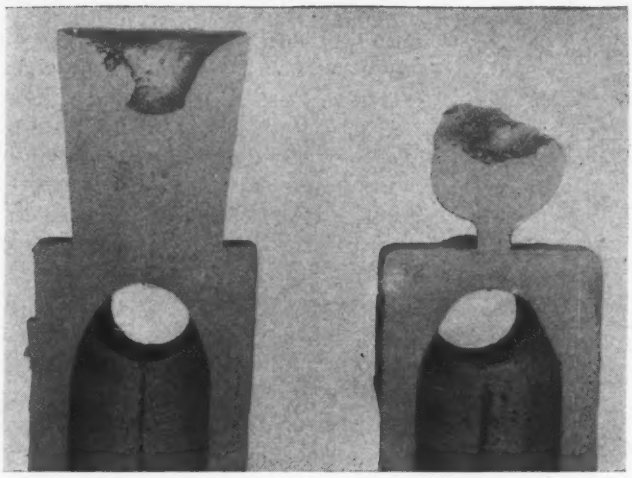


Fig. 12—Hollow tee castings poured vertically. (Left)—in a sand mold and with uninsulated riser; (right)—in a sand mold with an insulated riser; total weight of uninsulated riser casting—18½ lb., insulated riser casting—13½ lb. Manganese bronze.

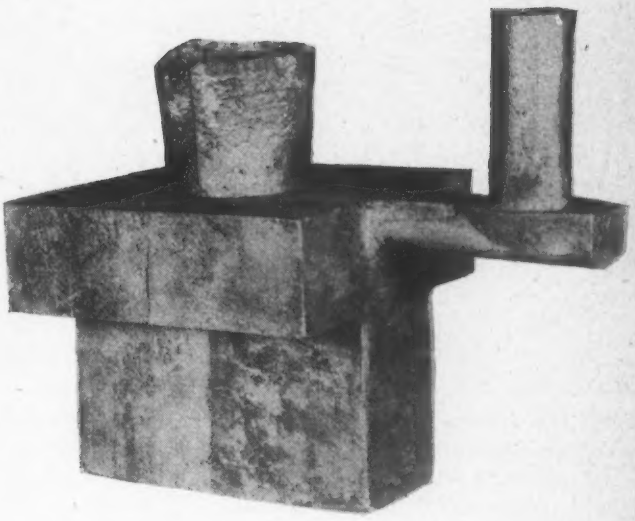


Fig. 13—Photograph of solid tee test casting.

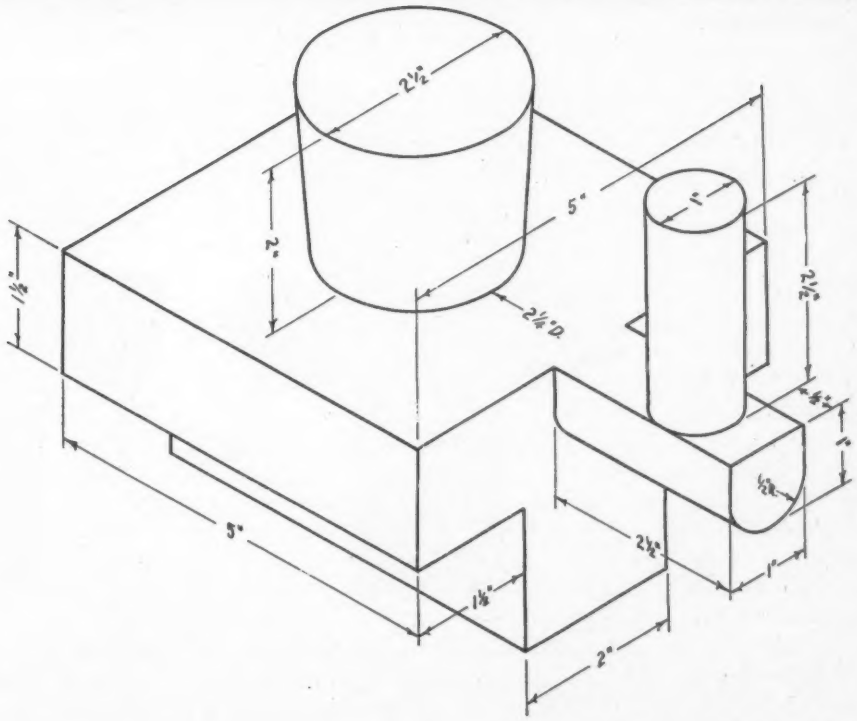


Fig. 14—Sketch of solid tee test casting showing dimensions.

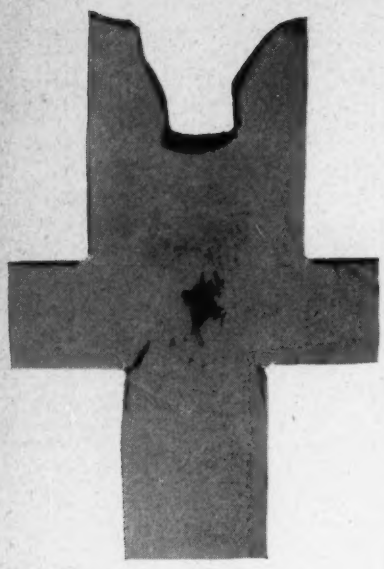


Fig. 15—Section of solid tee casting made entirely in sand, showing effect of atmospheric pressure and inadequate riser; manganese bronze; poured at 1830° F.

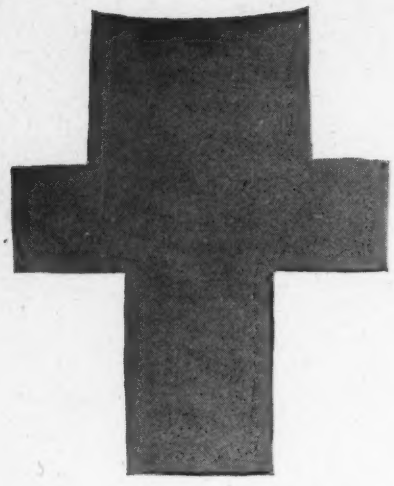


Fig. 16—Section of solid tee casting made with an insulated riser sleeve, showing a completely sound casting, manganese bronze; poured at 1000° C. (1830° F.).

The commercial use of gypsum as a mold material for making non-ferrous castings and its well-known insulating effect when used for this purpose suggested it as a material with which to accomplish in the non-ferrous field that which has not been as yet satisfactorily accomplished for casting of steel. Gypsum cannot be used with ferrous metals because of the reaction between the sulphur of the gypsum and the iron.

Figures 1, 2, 3, and 5 illustrate practical examples of the insulating value of gypsum when used in a mold for casting copper-base alloys. Figures 1 and 2 show the first experiment made to determine the relative rates of heat transfer through sand and gypsum molds. One half of the mold was made completely in gypsum and the other half in green sand. The casting cavities were gated identically, were of identical dimensions, and thermocouples were placed so that the temperature would be measured in the center of each mold.

The metal used was manganese bronze poured at 1875° F. (1025° C.). The time for complete solidification as indicated by the thermocouples was more than twice as long in the insulated metal as in the uninsulated metal (Fig. 2 chart). It is interesting to note the difference in temperature of the metal at the time of the first reading, indicating immediately the relative insulating properties of the gypsum, and the much greater absorption of heat by sand as the metal flowed over it.

It will be noticed from the curve that the liquid metal inside the insulated casting approaches the solidus range much slower than it does in the sand casting, and a supply of liquid metal is available for a longer period of time to feed the shrinkage of a solidifying casting.

Fluidity spirals are used at the Naval Research Laboratory as a means for indicating the flow behavior (fluidity) of molten steel[6]. The length of flow is taken as a relative index of the fluidity of the metal. The spiral length is really an indication of how far the metal will flow before enough heat is lost to the mold to cause solidification.

Figure 3 shows a pair of such spirals, one poured in a gypsum mold and the other in sand. The relative length of 34 in. for the gypsum and 15 in. for the sand indicates in a rough way the relative insulating values of the two materials. Pure copper was used for the experiment. Both spirals were poured at 2150° F.

Figures 4 and 5 illustrate still further the good insulating properties of gypsum. Figure 4 is a sketch showing how the casting was made. An octagonal cavity in a green sand mold was filled by pouring molten manganese bronze through the open top. The metal was covered with an insulating powder after filling the mold.

As shown in the sketch, each alternate face of the octagon was formed with a slab of the material to be tested. At the end of 5 min. the cope and drag molds were separated and the unsolidified metal was bled out. Figure 5 shows a section through the center of the casting, and the lack of solidification on the gypsum face is clearly indicative of the insulative properties of this material.

This test demonstrates how effec-

Fig. 17—Section of solid tee casting made entirely in sand; etched surface shows shrinkage at internal angles; "G" bronze; poured at 1150° C. (2100° F.).

Fig. 18—Section of solid tee casting made with an insulated riser; etched surface shows casting sound. "G" bronze; pouring temperature 1150° C. (2100° F.).

tively several of the well-known materials can be used to promote the vitally important directional solidification within a mold cavity. The two contrasting materials were steel and gypsum, the former producing a wall thickness of 1¾-in. while the latter had retarded the heat flow so drastically that no skin had formed after the 5-min. period. From this experiment alone it can readily be seen that by using these materials in conjunction with conventional mold mediums a much greater control of directional solidification is available.

In order to test the practical value of pads and riser sleeves made from gypsum two typical castings were selected, one involving cored holes and thin sections and the other a solid mass containing troublesome internal corners. Figure 6 is a photograph of an actual casting and Fig. 7 illustrates schematically the molding technique used and the dimensions of the casting.

In Figs. 8 to 11, inclusive, four sectioned manganese bronze castings of this type are shown; each was made differently to illustrate the advantages of gypsum insulators. The casting shown in Fig. 8 was made completely in sand by ordinary foundry technique. No chills or insulators were used, and no insulating powder was used on the top of the riser.

Extensive shrinkage is evident in the heavy section at the lower corner beneath the riser. Freed metal could not reach this heavy section to accommodate shrinkage because the thin section solidified first and prevented further feeding. It is important to note the typical secondary shrinkage of the riser in the central portion.

In the casting shown in Fig. 9 no change was made except to place a small pad of gypsum against the thin section at the end, as shown in the sketch of Fig. 9, to retard solidification in this area and make it possible to feed the heavy corner section. The casting is sound and adequate feeding has been accomplished. In Fig. 10 no insulating pad was used at the light section but the casting was made with insulating sleeves around the riser and with insulating powder on top, as the photograph indicates.

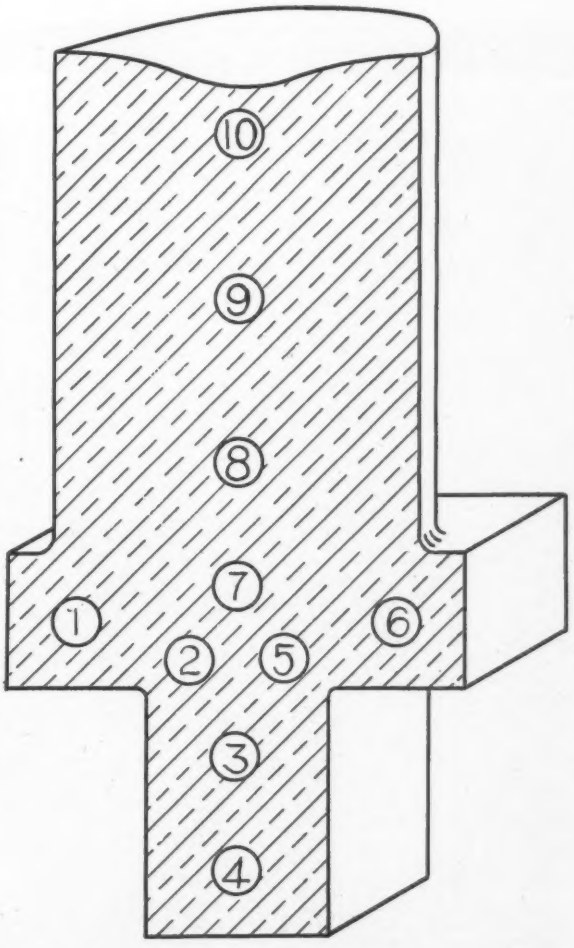
Fig. 19—Four solid tee castings made in the same mold; two made with insulated risers (2-P and 4-P) and two made in sand (1-S and 3-S). "G" bronze; pouring temperature 1150° C. (2100° F.).

By careful examination a very small pinpoint cavity of shrinkage is evident in the heavy corner section, but the casting is very nearly sound and feeding is almost adequate even though no pad was used

PLASTER		
SPECIMEN NO.	TENSILE STRENGTH P.S.I.	PERCENT ELONG. IN 2"
1	41,200	50.7
2	36,400	32.0
3	35,750	33.6
4	37,300	33.6
5	38,100	46.1
6	41,180	48.5
7	41,000	44.5
8	39,100	41.4
9	31,800	25.0
10	* ——	——

*Riser too short

TABLE 1



SAND		
SPECIMEN NO.	TENSILE STRENGTH P.S.I.	PERCENT ELONG. IN 2"
1	33,080	23.4
2	* ——	——
3	28,500	19.5
4	35,220	25.8
5	18,250	5.5
6	32,100	23.4
7	14,400	7.0
8	* ——	——
9	35,400	32.2
10	39,400	51.5

*Broken during machining

TABLE 2

Fig. 20—Sketch of solid tee casting showing location of test specimens and test values; Table 1, insulated riser; Table 2, uninsulated riser.

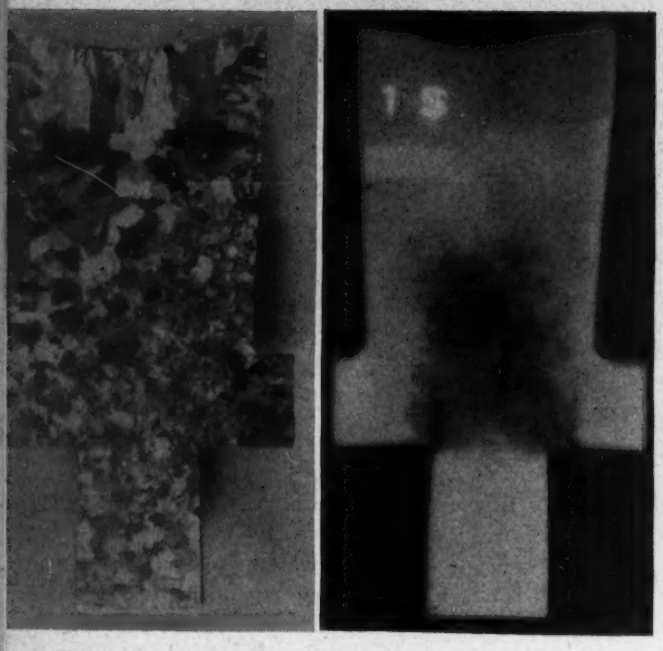


Fig. 21 (left)—Etched section of solid tee casting made in sand with uninsulated riser; broken grain pattern is indicative of shrinkage. "G" bronze; pouring temperature 1150° C. (2100° F.). Fig. 22 (right)—Radiograph of section shown in Fig. 21. Casting unsound.

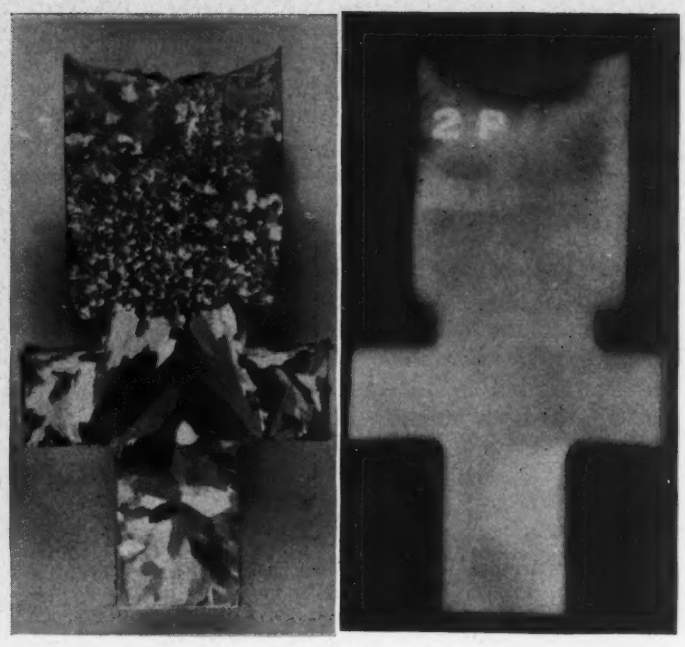


Fig. 23 (left)—Etched section of solid tee casting, made with insulated riser. "G" bronze; pouring temperature 1150° C. (2100° F.). Fig. 24 (right)—Radiograph of section shown in Fig. 23. Casting sound.

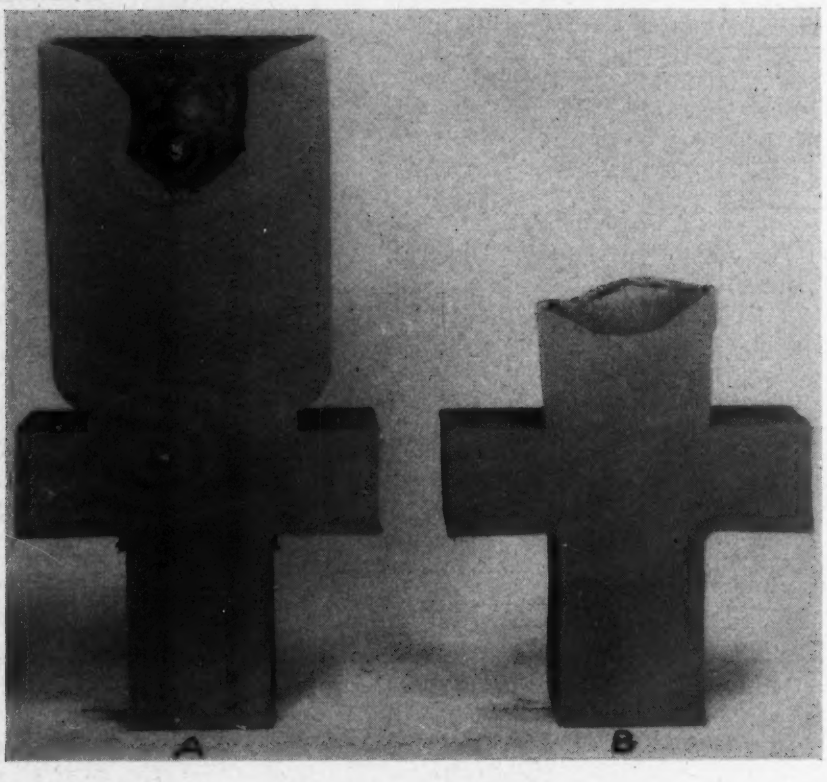


Fig. 25—Solid tee castings made in sand showing relative sizes of riser needed to produce a sound casting with and without insulation. Manganese bronze; pouring temperature 1000° C. (1830° F.). Total weight of A—35 lb., B—21¾ lb.

Fig. 26—Etched section of gear blank; the broken grain pattern in the midsection of the casting and riser is indicative of shrinkage; sand cast; uninsulated risers. "G" bronze; poured at 1150° C. (2100° F.)

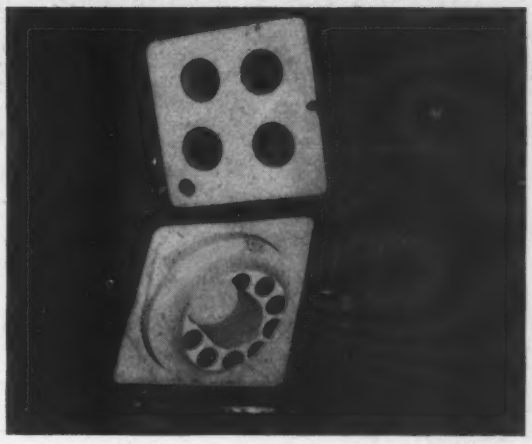


Fig. 27 (left)—Mold for bronze gear blank of Fig. 26 showing chills in drag and risers in cope.

Fig. 28 (right)—Gear blank casting of Fig. 26; total weight 122½ lb., casting weight 50½ lb.

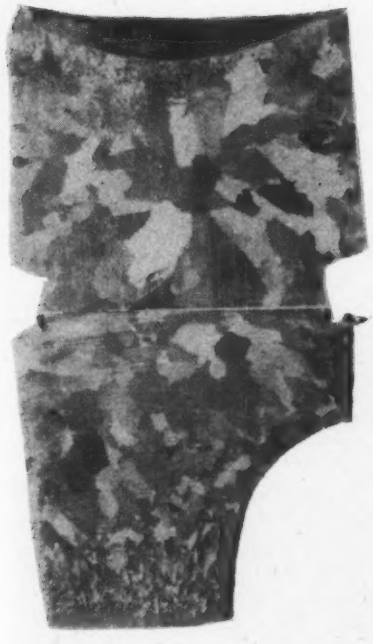


Fig. 29—Etched section of gear blank; the clearly defined grain pattern is indicative of proper directional solidification; sand cast; insulated risers. "G" bronze; pouring temperature 1150° C. (2100° F.).

Fig. 30 (right)—Mold for casting of Fig. 29 showing location of chills in drag and insulated riser sleeves in cope.

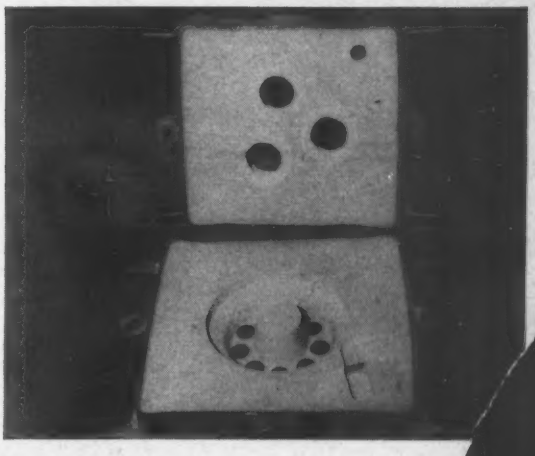


Fig. 31 (left)—Gear blank casting of Fig. 29; weight of casting 55½ lb., total weight 87 lb.

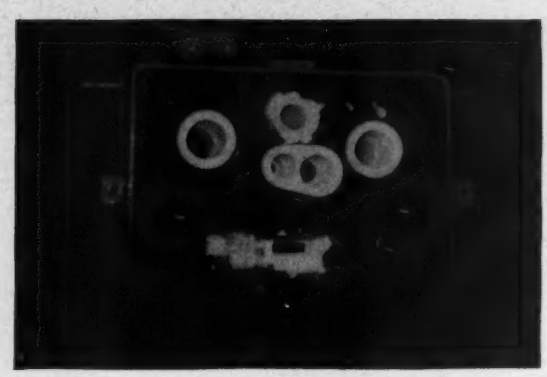


Fig. 33—Cope of mold showing insulated riser sleeves in position.

Fig. 32—Mold for valve casting showing core and location of risers.

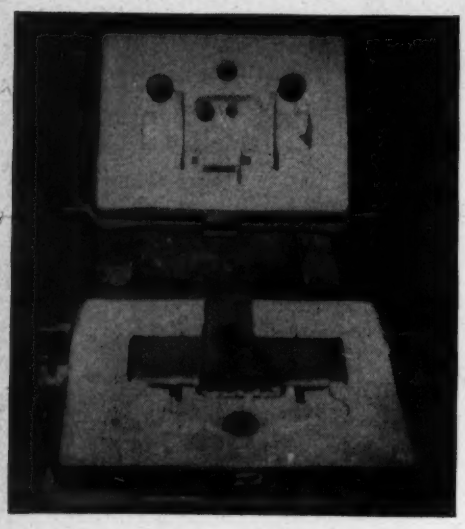


Fig. 34—Valve casting made with insulated risers. "G" bronze; pouring temperature 1150° C. (2100° F.).

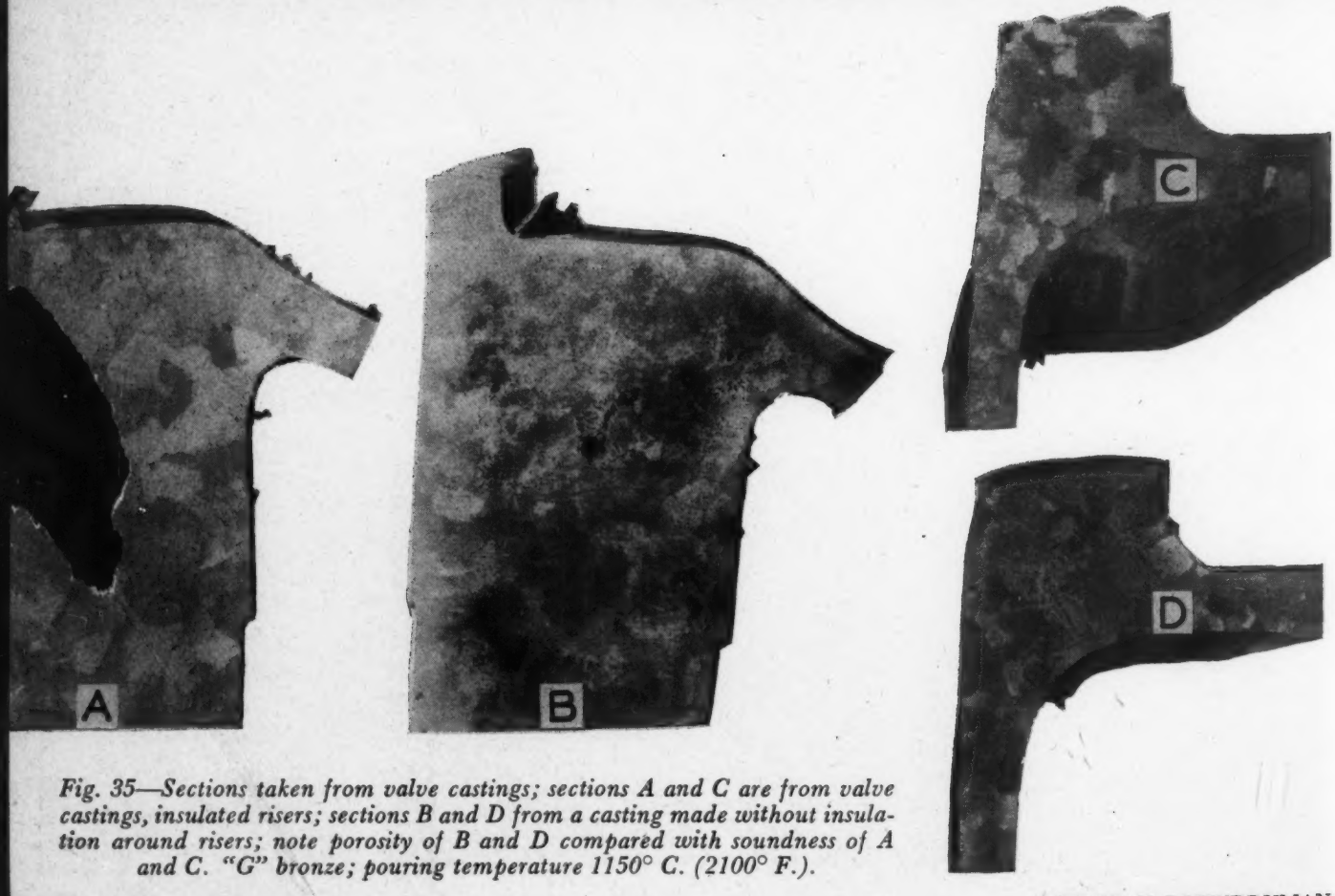


Fig. 35—Sections taken from valve castings; sections A and C are from valve castings, insulated risers; sections B and D from a casting made without insulation around risers; note porosity of B and D compared with soundness of A and C. "G" bronze; pouring temperature 1150° C. (2100° F.).

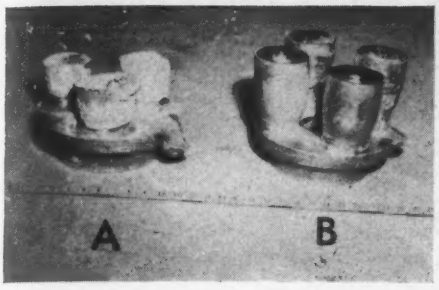


Fig. 36—Manganese bronze gear blanks made with A—insulated risers, and B—uninsulated risers; casting weight—55 lb., total weight of A—75 lb., total weight of B—119 lb.

Fig. 37—Manganese bronze gear blank made with two large uninsulated risers.

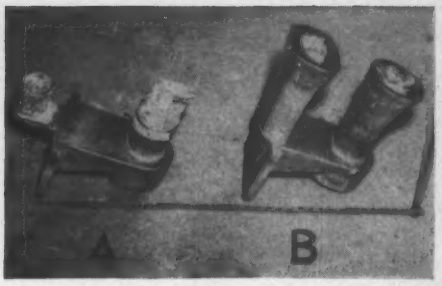


Fig. 38—Comparison of two similar manganese bronze castings made with A—insulated risers, and B—uninsulated risers.

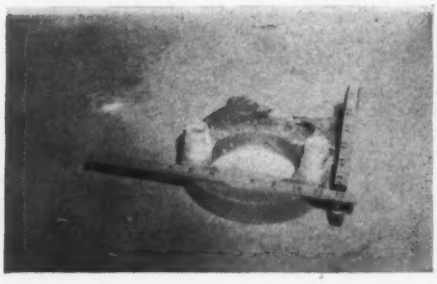


Fig. 39—Manganese bronze ring casting showing small insulated blind risers.

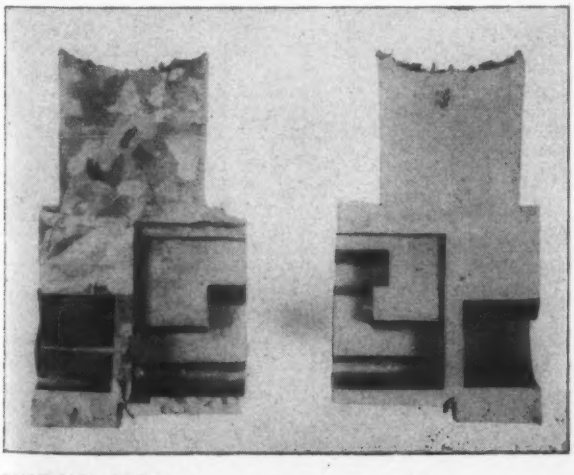
Fig. 40—Globe valve casting; "G" bronze; made with uninsulated risers. Total weight—72 lb.

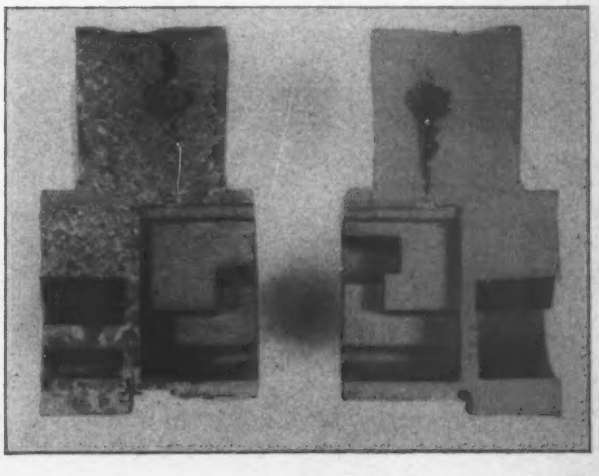
Fig. 41—Globe valve casting; "G" bronze; made with insulated blind risers. Total weight—55 lb.

Fig. 42 (right)—Shop casting showing molding method; "G" bronze.

Fig. 43—Sectioned shop casting made with plaster cores and insulated riser in a sand mold and showing complete soundness. "G" bronze; poured at 1150° C. (2100° F.).

Fig. 44—Sectioned shop casting made with plaster cores and uninsulated riser in a sand mold and showing the effect of atmospheric pressure. Note shrinkage cavity and broken grain pattern. "G" bronze; poured at 1150° C. (2100° F.).





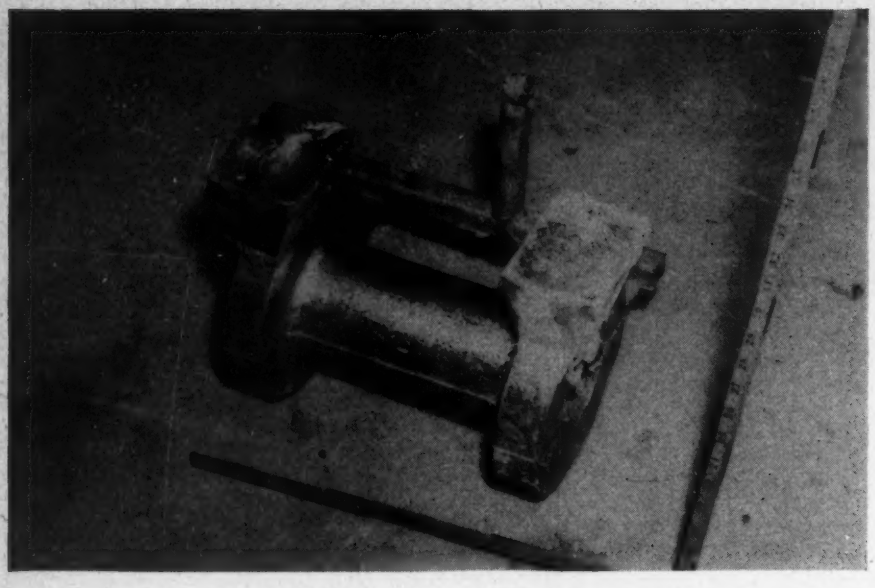


Fig. 45 (left)—Flanged pipe casting made with uninsulated riser on left flange and insulated riser on right flange. Manganese bronze; pouring temperature 1000° C. (1830° F.).

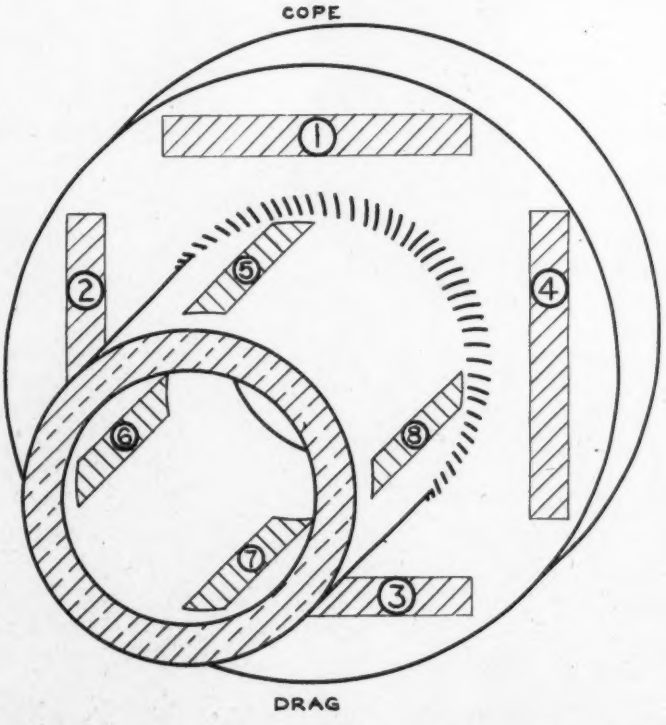
on the thin end section. The insulating effect of the sleeves extends far enough to cause the thin section to remain open sufficiently long to nearly feed the shrinkage in the heavy section. The absence of any trace of secondary shrinkage in the riser and the flatness of the top are very important features of risers cast in gypsum insulators.

The risers of Figs. 8, 9, and 10 were filled to the same height originally, but the final riser height of the insulated riser of Fig. 10 is ⅜-in. shorter than the others. This indicates that the metal in insulated risers settles as a molten body and does not freeze along the walls as in the case of sand risers.

The significance of this is very important as it means that all the molten metal in the riser is available for feeding over a greatly extended period of time, whereas with the riser in sand, a late feed demand within the casting must be accommodated by metal draining from the central part of the riser. The results of the thermocouple experiment previously discussed indicate also that the feed metal in sand risers is colder and less effective than in insulated risers.

Figure 11 shows a casting in which the riser size was reduced almost to a minimum by the use of a gypsum sleeve and necked down to facilitate removal from the casting. An insulating pad was used at the thin section. Made in this way the casting is sound, the riser is easily removed, and the amount of riser metal is small. No attempt was made to develop optimum gating conditions. The technique shown is not recommended as best, and any number of gating systems could have been used just as readily.

The castings of Fig. 12 are of manganese bronze and were made by pouring the molten metal directly into the risers. The castings were poured vertically as shown. The casting at the left in Fig. 12 (weight 18½ lb.) was made in a sand mold with the riser in sand and the one at the right (weight 13½ lb.) in a sand mold with the riser insulated. Due to the secondary shrinkage evident in the uninsulated riser it could not have been made materially smaller without producing a degree of unsoundness in the casting.



SAND

SPECIMEN NO.	TENSILE STRENGTH P.S.I.	PERCENT ELONG. IN 2"
1	73,250	32.8
2	72,750	26.8
3	74,150	35.9
4	71,750	24.2
5	67,250	15.7
6	65,500	14.8
7	66,000	14.8
8	73,250	28.1

TABLE 3

PLASTER

SPECIMEN NO.	TENSILE STRENGTH P.S.I.	PERCENT ELONG. IN 2"
1	72,250	27.4
2	74,000	32.8
3	74,200	35.2
4	73,750	34.4
5	63,750	12.5
6	72,200	21.1
7	70,250	20.3
8	74,200	28.1

TABLE 4

Fig. 46—Sketch of flanged pipe casting showing location of test specimens. Table 3—uninsulated riser, Table 4—insulated riser.

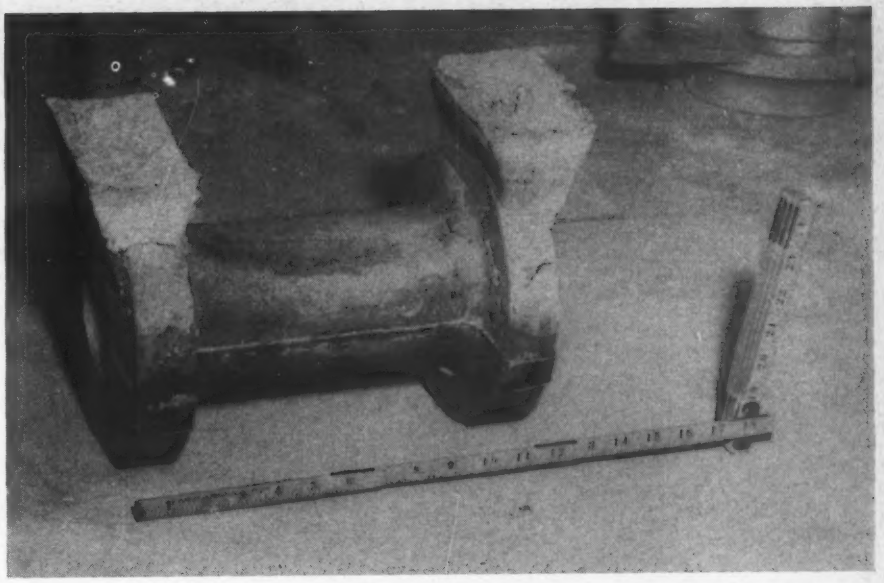


Fig. 47 (right)—Flanged pipe casting made with insulated riser on left flange and uninsulated riser on right flange. "G" bronze; pouring temperature 1150° C. (2100° F.).

The second test casting chosen was the type shown in Figs. 13 and 14. Because of the compact mass and sharp internal corners such a casting usually is difficult to make in the foundry unless extremely large risers are used. The sketch, Fig. 14, gives the details of the casting, gate and insulated riser.

Figures 15 to 18, inclusive, are photographs of sections of solid tee castings made as indicated. Several very interesting and important metallurgical and foundry principles are evident from these illustrations. For example, the effect of atmospheric pressure is clearly shown in Fig. 15. The riser, being too small and uninsulated, froze prematurely at the neck and could not supply molten metal to feed the shrinkage taking place in the casting.

As a result a partial vacuum was created within the casting, setting up a difference in pressure between the inside and outside of the casting which exceeded the strength of the solidified skin of metal, and the walls were forced inward at the internal corners. The extensive tear is actually caused by this condition, and if the casting were thoroughly sectioned and examined it would be likely that filaments of the tear actually reached through the solid wall and made contact between the inside cavity and the atmosphere.

The casting shown in Fig. 16 was made identically with that of Fig. 15 with the exception of a gypsum sleeve around the riser and powdered gypsum on top of the riser. Both castings were made of manganese bronze which was poured at 1000° C. (1830° F.).

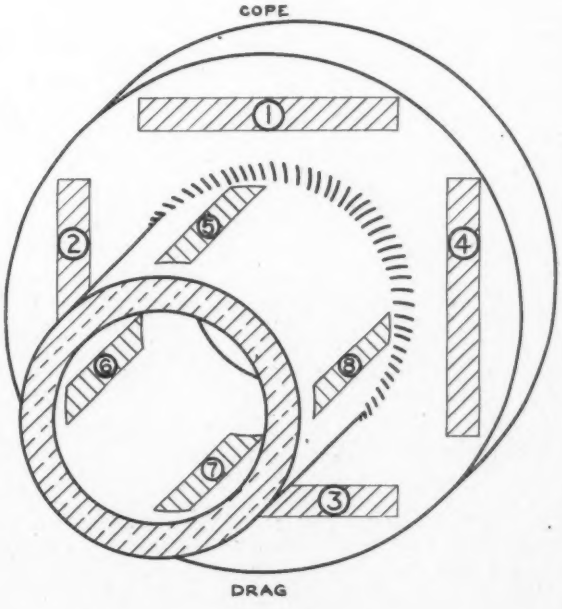
Figures 17 and 18 show castings made in the same way as those of Figs. 15 and 16 except that composition "G" bronze was used. The sections were etched in a solution of 1:1 nitric acid and water, in order to shown the typical shrinkage at the internal corners of the casting (Fig. 17) made without insulating the riser. The interdendritic type of shrinkage in tin bronzes is not readily apparent to the eye on polished surfaces unless they are etched, whereas the piping type of shrinkage in manganese bronze is clearly evident.

The broken, undefined grain seen at the internal corners (Fig. 17) depicts shrinkage, and the slight caving in of the corners again shows the effect of atmospheric pressure acting on a low density area. The

SAND		
SPECIMEN NO.	TENSILE STRENGTH P.S.I.	PERCENT ELONG. IN 2"
1	* ———	—
2	26,800	15.7
3	18,300	7.8
4	23,100	9.4
5	42,500	40.6
6	41,950	42.2
7	41,200	35.2
8	39,550	31.2

* Broken during machining

TABLE 5



PLASTER		
SPECIMEN NO.	TENSILE STRENGTH P.S.I.	PERCENT ELONG. IN 2"
1	37,700	53.1
2	33,800	23.4
3	36,600	25.8
4	33,100	23.4
5	43,000	48.5
6	42,600	44.5
7	46,100	49.1
8	44,600	52.3

TABLE 6

Fig. 48—Sketch of flanged pipe casting showing location of test specimens. Table 5—uninsulated riser, Table 6—insulated riser.

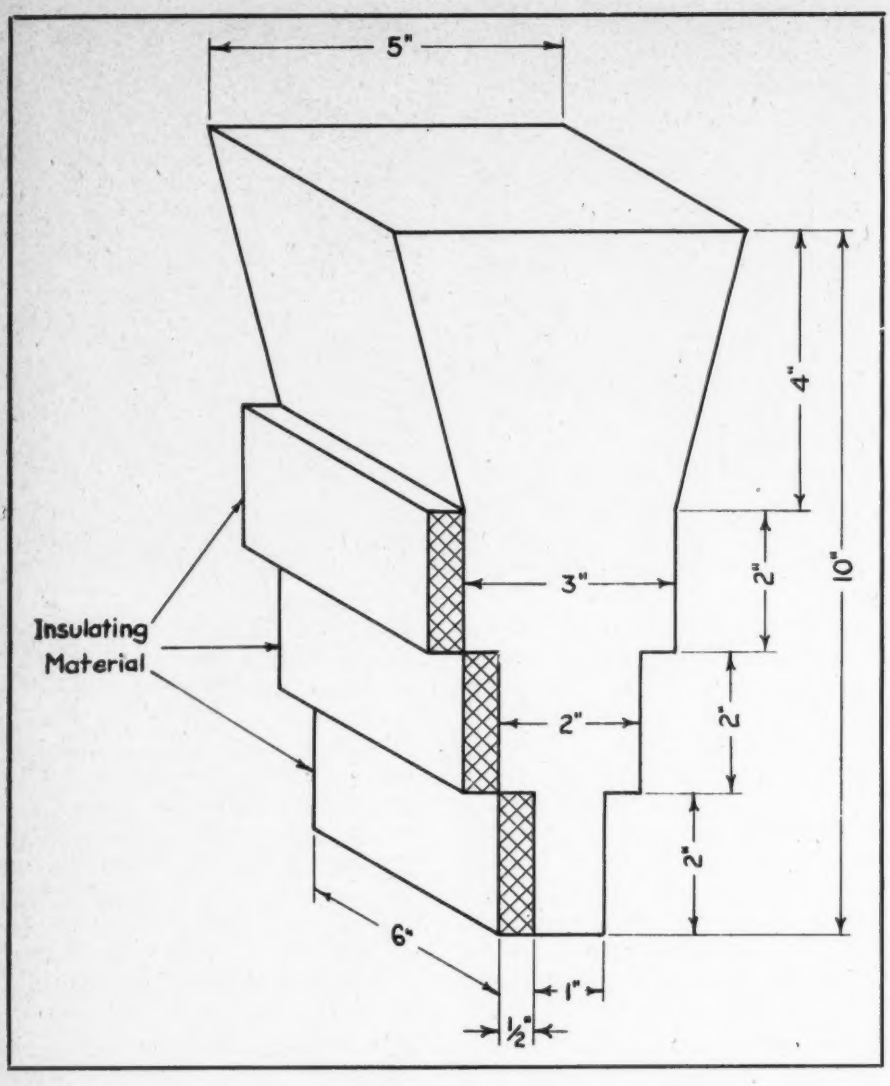


Fig. 49—Sketch of step casting showing dimensions and method of making tests (Figs. 49, 50 and 52).

risers of the two manganese bronze castings (Figs. 15 and 16) originally were poured to the same height.

As in the instance previously discussed, the metal in the insulated riser has settled down as a body and no secondary shrinkage is present. This same phenomenon is shown in a somewhat lesser degree in a comparison of Figs. 17 and 18.

Figure 19 is a photograph of four identical castings made in the same mold to insure as nearly as possible identical pouring conditions. Two of the castings were made with insulated risers and two were not. The metal used to pour these castings was composition "G" bronze (88 Cu, 9 Sn, 3 Zn).

Poured at 1150° C. (2100° F.) one pair of castings was used to study physical properties by cutting blanks for tensile specimens from the positions shown in the sketch in Fig. 20. The results of this comparison are shown in the Tables 1 and 2 on either side of Fig. 20, and the casting made with the insulated riser proved superior in soundness, as shown by the tensile properties.

The other two castings were sectioned and a ½-in. thick slab was removed transversely from the center of each. This thin slab was radiographed and later etched to show relative soundness. The results are shown in Figs. 21 to 24, inclusive, which are self-explanatory. To the casual observer the macrostructure shown in Fig. 21 might not be particularly disturbing because the shrinkage is not evident as extensive voids.

However, the radiograph of Fig. 22 shows the defect in its true light. Adequate feeding is not present. No insulation of any type was used on this riser. The casting of Figs. 23 and 24 is sound and shows no porous areas when etched or radiographed. Again much significance can be given the metallurgical and foundry principles displayed.

The broken, poorly defined grain of the casting shown in Fig. 21 is proved by the radiograph of Fig. 22 to be indicative of low density, whereas the larger, clearly defined, clean grain of Fig. 23 is indicative of sound metal. It is interesting that due to rapid dissipation of heat by radiation, the grain structure in the upper part of the riser in Fig. 21 indicates the metal in this area to be sound with a porous region beneath.

The importance of studying the soundness of castings by x-raying thin slabs removed from critical areas cannot be emphasized too strongly. It is safe to say that an x-ray taken through the entire casting of Fig. 21 would not have shown too clearly the extent of the voids. X-ray pictures taken normal to the main plane of a defect do not show the defect in its more serious aspects.

Measured under such conditions the actual magnitude of the defect may equal only about 3 per cent of the total thickness of the casting, an

Fig. 50—Section of step casting showing gas porosity inside casting skin on uninsulated side; indicating slower skin formation rate on insulated side allowing gas to escape. "G" bronze; pouring temperature 1150° C. (2100° F.).

Fig. 51—Section of step casting; right side uninsulated; left side insulated. Brinell hardness survey indicated slight difference in hardness from right to left; etched to show grain pattern. "G" bronze; pouring temperature 1150° C. (2100° F.).

amount which approaches the lower limit of sensitivity of film. However, a thin section cut transversely across an unsound area presents a maximum percentage of defective metal for the x-ray to reveal and maximum sensitivity is obtained.

It is true that in this sense radiography becomes a destructive rather than a non-destructive test, and the technique could not be used for routine inspection. However, it can be used to great advantage as a research tool and as a means for critically inspecting pilot castings.

The casting of Fig. 25*(A)* weighed 35 lb. as cast and shows the solid tee-block casting of manganese bronze made sound by using the smallest possible riser without the aid of insulation. A smaller riser caused the secondary shrinkage to reach into the casting. Figure 25*(B)* shows the same casting made sound with an insulated riser of greatly reduced size. The casting weighed 21¾ lb.

In the various experiments no attempt was made to determine the effect of riser design upon the relative feeding efficiencies of uninsulated risers. Improvements in the design of uninsulated risers would also improve the behavior of insulated risers, and this should be a subject for independent investigation. The straight-sided riser is certainly not the optimum design.

Several shop castings of a miscellaneous nature made in the foundry during the progress of the experimental work indicated the practical significance of the development. These castings are of sufficient interest for detailed discussion.

The tin bronze gear blank shown in Fig. 28 is of 10-in. diameter and the finished casting weighed approximately 50½ lb. after the risers had been removed. The mold for this casting made with uninsulated risers is shown in Fig. 27. Round chills were placed as shown in the drag. Several attempts to make the casting with fewer and smaller risers failed, and even with the arrangement shown, a slight amount of shrinkage was found when thin transverse slabs were cut from several positions and radiographed.

The macrostructure shown in Fig. 26 is again typical of castings made with uninsulated risers. The fine-grained structure immediately above the chills is caused by a different phenomenon than that which causes the apparently fine grain in imperfectly fed sections, and is sound where the latter is not.

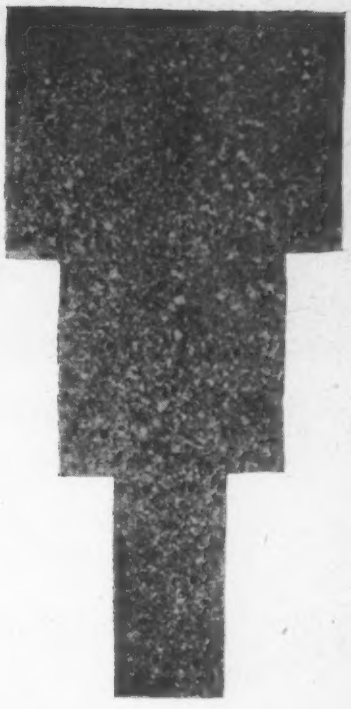


Fig. 52—Section of step casting made and tested same as in Fig. 49 and showing same relative properties. Manganese bronze; pouring temperature 1000° C. (1830° F.).

The method used for making this casting with insulated risers is shown in Figs. 27 and 28. Figure 29 shows the clean, well defined structure with the grains progressively larger toward the riser, indicative of sound tin bronze, and x-ray examination revealed a completely sound casting.

Fig. 53 (left)—Assortment of riser sleeve mold forms used to make insulated riser sleeves. Fig. 54 (right) —Assembled mold forms for making insulated riser sleeves.

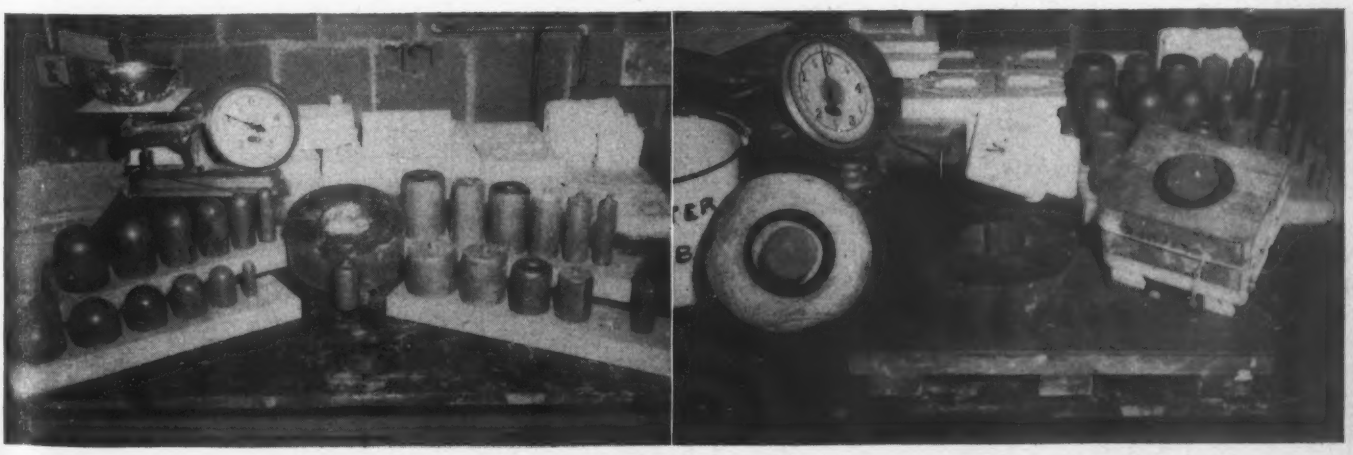


Fig. 55—Brushing separating agent on mold form.

Fig. 56—Weighing water for plaster slurry.

Fig. 57—Weighing gypsum for plaster slurry.

Fig. 58—Sprinkling weighed gypsum onto surface of weighed water.

Fig. 59—Hand mixing gypsum and water to form a smooth, lump-free slurry.

Fig. 60—Pouring slurry into mold forms.

Fig. 61—Striking off excess plaster before the riser sleeve is removed from the form.

Fig. 62—Removing the "set" riser sleeve from the form.

Fig. 63—An assortment of insulating riser sleeves.

Fig. 64—Placing the green plaster sleeves in oven for drying before use.

Both castings, however, appeared to be sound when tested non-destructively by x-ray examination of the whole casting. Figure 30 shows the insulated riser sleeves in place and Fig. 31 shows the casting. Three risers were used in this case as compared with four in the former.

A particularly interesting development is shown in Figs. 32 to 35, inclusive. The casting shown in Fig. 34 is a "G" bronze valve which has been extremely troublesome in production at the Norfolk Navy Yard. A cooperative project was arranged to determine if the use of insulated risers would improve the soundness of this critical casting and reduce the number of castings rejected after pressure testing.

The casting was approximately 15 in. long, 8 in. in diameter, and the average wall thickness was 5/16 to 3/8-in. in the body and 3/4-in. on the flanges. The experiment consisted of making two castings simultaneously without changing the original gating or risering system. One casting was made with insulation placed around the riser, as shown in Fig. 33, and powdered insulator placed on the metal in the open riser.

The other casting was made with uninsulated risers and no insulating compound placed on the metal in the risers. Photographs of typical sections cut from critical parts of the casting are shown in Fig. 35. The sections designated *A* and *C* represent the casting made with the insulated risers.

This casting was sound when inspected by x-ray and did not leak under routine pressure tests at the Norfolk Navy Yard. Of interest is the special double riser sleeve made to accommodate the two risers of different size which were placed so close together that two individual riser sleeves could not be inserted.

Several typical castings made to indicate the practical advantages of riser insulation are shown in Figs. 36 to 41, inclusive. Figure 36 shows again the previously discussed gear blank casting for purposes of comparison with the technique used in making the casting shown in Fig. 37. These castings shown in Fig. 36 (*A* and *B*) are of manganese bronze.

The casting *A* in Fig. 36 was made with 3 insulated risers of 4-in. diameter and 4 in. high, "necked in" to 3-in. diameter at the casting junction. These risers produced a perfectly sound casting. The casting *B* in Fig. 36 was cast in the same manner except that four uninsulated risers were used, each being of 4-in. diameter and 6 in. high.

These risers were inadequate and, consequently, at the base of each riser atmospheric pressure caused a "dish" or pocket in the casting. The casting shown in Fig. 37 was of the same order of soundness as the one made as shown at *A* of Fig. 36.

Figure 38 shows a shaft hanger casting made (*A*) with and (*B*) without insulating risers, and Figs. 40 and 41 show a similar arrangement with a valve casting. Figure 39 shows the use of insulated blind risers placed above the ring casting. This technique supplies adequate feed metal without the necessity of

bringing the riser through to the top of the mold.

Another interesting tin bronze casting is shown in Fig. 42. It was necessary to make the surfaces of the cored parts of the casting sufficiently smooth to provide a sliding fit for another part without benefit of machining or grinding. The surfaces of non-ferrous castings made previously in gypsum were extremely smooth and indicated the possibility of using it as a core material.

The casting shown in section as Fig. 44 was made with gypsum cores. The riser and outside of the casting were molded in ordinary sand. The unetched section of Fig. 44 is particularly interesting as it shows how the riser froze over at the top due to radiation and how atmospheric pressure broke through the skin of the casting beneath the riser to relieve the partial vacuum developed due to shrinkage inside the riser.

The gypsum cores conducted heat less readily than the sand and all surfaces next to the sand froze first. The hot spot was located beneath the riser instead of at the top of the riser where it should have been. Figure 43 shows the casting made with gypsum cores and insulated riser, the outside of the casting proper being in sand. The riser in this case is excessive. In spite of the difference in grain structure between the castings of Figs. 43 and 44, the composition and pouring temperature of the metal are the same for each.

Flange Fittings

Figures 45 and 47 present photographs of flanged fittings made of manganese bronze and composition "G," and physical properties obtained from specimens cut from the castings in the locations shown in the sketch of Figs. 46 and 48.

The results are self-explanatory and no attempt is made to expand upon their significance as too few such tests were made to be conclusive. However, it is interesting to note that the large difference in the physical properties of the "G" bronze casting between the light pipe section and the heavy flange section is reduced when insulation is used on the risers.

The sketch of Fig. 49 shows how the step castings of Fig. 50, 51, and 52 were made. As shown, one side was insulated and the other was not. The metal used to pour the composition "G" bronze casting of Fig. 50 was not properly deoxidized and was gassy.

It is interesting to note that in spite of this, the section of casting adjacent to the insulation was sound. Evidently solidification was retarded sufficiently to allow the gas to escape. The unsoundness of the castings next to the sand is often found in "G" bronze castings not properly degassified. The "G" and manganese bronze castings of Figs. 51 and 52, respectively, were sectioned, etched, and tested for hardness as indicated.

The hardness was uniform throughout, although one side solidified against a sand surface and the other was insulated. Large risers were used above the largest section in each case and feeding was adequate. The hardnesses are approximately the same as for sand castings.

Conclusions

The information presented in this report permits the following conclusions to be drawn:

a. Controlled directional solidification is essential to the manufacture of sound non-ferrous castings. This can best be obtained by careful attention to gating and risering practices.

b. The interdendritic shrinkage of "G" bronze and the gross shrinkage of manganese bronze have a similar origin—lack of sufficient feeding—which can be corrected by proper control over the temperature gradients within the solidifying casting.

c. Atmospheric pressure operates to the advantage or disadvantage of casting soundness in non-ferrous metals to fully as great an extent as it does in steel, and the principles of operation are identical. Whether good or poor castings result depends upon how well this important foundry tool is understood and applied. Theories and techniques have already been worked out by steel foundrymen and should be carefully studied by non-ferrous foundrymen interested in improving their practices. Although fundamental principles apply similarly to all metals, techniques vary somewhat.

d. The x-ray is a powerful tool in revealing unsoundness in non-ferrous castings which is not readily apparent by other testing methods. X-ray studies of thin, transverse sections cut from pilot or test castings will do much to improve gating and risering practices if careful attention is paid to the radiographs.

e. Low density areas in non-ferrous castings are revealed on polished and etched cross sections by a broken, poorly defined grain pattern, usually surrounded by an area of larger clear-cut grains. The shrinkage then can be verified by x-rays of thin, transverse sections cut from the area.

f. A study of transverse x-rays can be used to indicate the reason for leakage in non-ferrous pressure castings. Improperly fed castings, particularly in "G" bronze, usually will show an extensive low density area surrounded by a relatively small amount of sound metal. The outside sound portions often are removed by machining and leakage takes place through the filamentary shrinkage voids.

g. It is possible that the major portion of rejects of non-ferrous castings are a direct result of inadequate feeding rather than the many other variables often blamed.

h. The feeding range and efficiency of risers when designed and used according to usual foundry practices are limited and considerably less effective than might be expected. These limitations exist because the molding sand around the risers is a relatively good conductor of heat and because of loss of heat by radiation to the air if open risers are not covered with some form of insulation.

i. It has been found possible to greatly increase the over-all efficiency of risers by insulating them and by using insulating pads on thin sections when it is necessary to feed through thin sections to reach heavier sections beyond. Gypsum, when used in the manner described in the Appendix, has been found to be an efficient insulator, economical and easy to fabricate into any desired shape. Gypsum powder is also used as an insulator by sprinkling it over the top of open risers.

Advantages of importance to foundrymen which result from the use of insulating pads and riser sleeves are as follows:

A. Sounder castings. (1) This is the result of the metal in the riser remaining molten until long after

the casting has solidified. (2) By use of the pads on thin sections the feeding range of risers is increased.

B. Increased yield. (1) The riser volume can be reduced by as much as 75 per cent in certain cases. The contact between riser and casting can be materially reduced. (2) This results in a markedly greater number of castings per ladle of metal.

C. Reduced cleaning cost. (1) Removal of risers and materials handling are simplified because smaller and often fewer risers are required. Also, the contact between riser and casting can be reduced to the point where the risers may be removed with a hammer blow.

Disadvantages are:

A. Cost of preparing and using the insulators. (1) This is not great as the materials are cheap and easy to handle. (2) Nothing is more expensive than an unsound casting.

B. Possibility of contamination of sand. (1) This can be prevented to a large extent by removing the powder and sleeves prior to the shake-out, or by making the prefabricated pieces strong enough to resist breaking up during the shake-out, so that they may be removed later. (2) The use of a new sand facing would eliminate the problem. (3) It is not expected that this would prove serious, but it is a problem which would have to be solved individually.

Acknowledgments

The authors wish to express appreciation to the various members of the Foundry and Research Staff for their interest and assistance, particularly to George Schmidt for the sketches which serve to clarify certain of the illustrations.

Appendix

The material used in making the insulating pads and riser sleeves discussed in this report was gypsum. A great variety of other materials suitable for use is available and several were tried, but none was superior to gypsum in insulating quality, general ease of fabrication, and cost. Since our interest is mainly in developing the theory and practical technology of a given foundry process or procedure, no attempt was made to test all possible materials or to develop new materials, particularly when gypsum proved so satisfactory.

Several different grades of gypsum are available for special purposes, and the type marketed for use in metal casting was used for the work described in this report. This particular grade has been developed specifically for use as molding material in making non-ferrous castings of superior surface appearance and to close tolerances. It is essentially plaster of paris (calcined gypsum) to which has been added 20 per cent of fibrous material.

The procedure for making riser sleeves and insulating pads with gypsum products is illustrated in Figs. 53 to 64, inclusive. Here are described various steps in the order of their occurrence, although variations may be necessary or beneficial to the practice of individual shops.

Method of Mixing

Figure 53 shows a number of wooden plugs and a wooden mold in which any one of the plugs may be placed to make either blind or open risers. The plugs on the left are used to form blind risers and those shown on the right make open risers, some of which are used as "necked-down" riser sleeves.

Assembled mold forms are shown in Fig. 54. The mold forms must be coated with a separating agent before the plaster slurry is poured into them, and this is illustrated in Fig. 55. The separating agent is a water-repellant coating, and usually is brushed on the mold but may in some cases be sprayed.

Figures 56 and 57 show water and gypsum being weighed to the proper proportions to give what is termed a 160 consistency. It will be found after little experience that the best and most practical way to mix the slurry is to sprinkle the gypsum on top of the water, as shown in Fig. 58, and allow it to settle or soak for approximately 2 min. before hand mixing.

Figure 59 shows a batch of slurry being hand mixed until it is of a lump-free, creamy consistency. After the slurry starts to cream or thicken it is poured into the riser sleeve form, or into a block form for use as insulating pads (Fig. 60). The plaster slurry becomes a solid mass approximately 15 min. after it is mixed, and any excess, as shown in Fig. 61, can be struck off even with the top of the form with a piece of flat metal or wood.

If the mold is properly coated with a separating agent, the "set" plaster sleeve will be easily removed from the form by a few gentle raps to break a vacuum which tends to form between plaster and mold surfaces. This is shown in Fig. 62. Various sizes and shapes of open riser sleeves are shown in Fig. 63, and Fig. 64 shows a number of green slabs of plaster as well as several riser sleeves ready to be dried in an oven before being used in the production of castings.

Plaster Consistency

Some explanation may be in order at this point to clarify the meaning of the term consistency. The word consistency as it is used in this report means the plaster to water ratio used in making insulating sleeves and pads. A 160 consistency which is used for all the sleeves and pads in this report means 160 lb. of water to 100 lb. of metal casting plaster. When the plaster to water ratio is maintained at or close to the 160 consistency, little if any cracking of the sleeves will occur during the drying operation.

If the dried sleeves are too soft and fragile for practical use, it may be desirable to make an addition of portland cement to the dry gypsum before it is added to the water. It has been found that 20 per cent of portland cement by weight added to the dry gypsum will substantially increase the mechanical strength of the dried sleeve with little or no effect on its insulating quality.

Drying Methods

Sleeves and insulating pads made of gypsum products must be dried before they are used in molding operations. The temperature that has been found to be satisfactory is from 400 to 1200° F., and the time necessary to dry a given sleeve or pad will depend upon the drying temperature.

If the higher temperature range is utilized for faster drying, a certain degree of cracking can be expected if the sleeves are removed from the furnace and air cooled to room temperature; however, slight cracks have no noticeable effect on the insulating qualities of the sleeves but do weaken them somewhat mechanically.

Several satisfactory parting or separating agents have been successfully used, such as stearic acid,

petroleum jelly, light lubricating oil, lard oil, etc. An emulsion of granulated soap, water, and light lubricating oil, 40 per cent, 30 per cent, and 30 per cent, respectively, by volume also works well as a mold form coating.

Several variations of plaster of paris have been tested and found to work very well as insulating materials for riser sleeves and pads if a few precautions are observed. In using 100 per cent plaster of paris it is necessary to keep the slurry in suspension until creaming or thickening has started, to prevent a settling action from occurring which will produce a dense, hard structure on the bottom of a riser sleeve and a porous, weak structure at the top.

An accelerator can be used to speed up the "set" of the plaster, thereby decreasing the time of "set." Approximately 1½ per cent of terra alba is a good proportion of accelerator to dry material.

Various materials, such as short-fibered asbestos, vermiculite (expanded mica), moldene or its equivalent, diatomaceous earth, and other such materials which will absorb water can be used satisfactorily with plaster of paris to insure uniform texture in the finished sleeves.

The metal compositions used for the tests illustrated in this report were as follows:

Manganese Bronze, per cent		*Composition "G" Bronze, per cent*
58.0	Copper	88 Copper
38.5	Zinc	9 Tin
1.0	Iron	3 Zinc
1.0	Aluminum	
0.75	Manganese	
0.75	Tin	

References

1. C. W. Briggs and R. A. Gezelius, *"Studies on Solidification and Contraction and Their Relation to the Formation of Hot Tears in Steel Castings,"* TRANSACTIONS, American Foundrymen's Association, vol. 41, pp. 385-448 (1933).

2. George Batty, *"Controlled Directional Solidification,"* TRANSACTIONS, American Foundrymen's Association, vol. 42, pp. 237-264 (1934).

3. C. W. Briggs and R. A. Gezelius, *"Studies on Solidification and Contraction in Steel Castings—III, The Rate of Skin Formation,"* TRANSACTIONS, American Foundrymen's Association, vol. 43, pp. 274-302 (1935).

4. J. A. Duma and S. W. Brinson, *Application of Controlled Directional Solidification to Large Steel Castings,"* TRANSACTIONS, American Foundrymen's Association, vol. 48, pp. 225-282 (1940).

5. H. F. Taylor and E. A. Rominski, *"Atmospheric Pressure and the Steel Casting—A New Technique in Gating and Risering,"* TRANSACTIONS, American Foundrymen's Association, vol. 50, pp. 215-259 (1942).

6. H. F. Taylor, E. A. Rominski, and C. W. Briggs, *"The Fluidity of Ingot Iron and Carbon and Alloy Cast Steels,"* TRANSACTIONS, American Foundrymen's Association, vol. 49, pp. 1-93 (1941).

Staff Additions

(Continued from page 44)

tional director, Gray Iron Founders' Society, Washington, D. C., who has had nearly 25 years' experience in public relations, publicity and advertising. Mr. Mullen's efforts also will be directed toward implementing the National Educational Program of A.F.A., an activity of the Technical Development Program.

John Mullen was assistant educational director, Investment Bankers Association, for nine years and thereafter gained extensive experience in editorial, publicity and public relations work for industrial, service and advertising organizations. From 1936 to 1943, he served as publicity director, Chicago Mercantile Exchange.

While connected with the Gray Iron Founders' Society, John Mullen became widely known in the gray iron foundry industry and was responsible for much of the society's work in publicizing the merchandising and technical needs of gray iron producers.

J. E. Foster

JOSEPH E. FOSTER, formerly metallurgist with the Dodge-Chicago plant, Chrysler Corp., Chicago, has joined the National Office Staff as an assistant to the Director of the Technical Development Program. A graduate of metallurgical engineering from the University of Illinois, Urbana, Mr. Foster holds membership in A.F.A. and ASM and has had considerable experience in foundry and other metallurgical work.

Prior to college, he served as inspector of heat treating and foundry production, International Harvester Co., Chicago. His experience also includes work with the metallurgical department, Rock Island Arsenal, Rock Island, Ill.; metallurgist, Olin Industries, Western Cartridge Co., East Alton, Ill., and as instructor in heat treatment of steel, Shurtleff College, Alton, Ill.

Study Flow of Heat Through Silica Sand

IN RESPONSE to a demand for fundamental information regarding rate of heat transfer through sand, the A.F.A. Committee on Heat Transfer, Foundry Sand Research Project, is initiating studies at Battelle Memorial Institute, Columbus, Ohio.

Heat flow through dry sand of several average grain sizes will be considered first. Later, determinations will be made under more complex conditions involving the effect of such factors as the presence of binders and gases.

An apparatus which maintains a constant elevated temperature on one side of a specimen, and a constant low temperature on the other side, will be used in the tests. Rate of heat flow will be calculated from temperature measurements taken at several locations in the specimen.

Results of the study, which are expected to be available in a few months, will be correlated with the other work of the committee. Sponsored by the Committee on Heat Transfer, extensive investigations are in progress at Columbia University, New York, where a heat and mass flow analyzer employing electric current to simulate heat flow conditions is in use; while experiments under actual foundry conditions are being conducted at Naval Research Laboratory, Washington, D.C.

Buy Malleable Foundry

PHYSICAL PROPERTY and equipment of Jewell Alloy & Malleable Co., Inc., Buffalo, have been sold to Ralph T. Rycroft, president of the company for the past ten years and an A.F.A. National Director, and Ward H. Kendrick, both of Buffalo.

The foundry will be operated under the name of Kencroft Malleable Co. Inc., and will continue the production of malleable and alloy castings, with tonnage output adjusted in the interest of most economical operation.

Mr. Rycroft will continue as president, and Mr. Kendrick will serve as vice-president.

Stockholders of the Jewell company having voted recently to liquidate, the corporation will be dissolved, but will retain certain inventories and assets temporarily.

★ NEW A. F. A. MEMBERS ★

(Covering the period from January 15 to February 15)

• Twenty-seven chapters out of the 33 contributed to the month's new member total of 168. Chicago again this month, as well as last month, leads with 19 additions. Birmingham and Central Illinois garnered 16 new names while Wisconsin showed an increase of 14.

Conversion Personal to Company
***The Medart Co., St. Louis. (Harold Goodwin, Fdry. Supt.)**

BIRMINGHAM DISTRICT CHAPTER

S. J. Billingsley, Mold. Fore., Stockham Pipe Fittings Co., Birmingham.
Amos Burchfield, Mold. Fore., Stockham Pipe Fittings Co., Birmingham.
H. A. Byrns, Gen. Supt., Woodward Iron Co., Woodward, Ala.
W. L. Cagle, Clean. Room Fore., Stockham Pipe Fittings Co., Birmingham.
Ormond C. Corry, V.P., Harrison-Corry Co., Knoxville, Tenn.
H. W. Gethin, V.P. & G.M., Alabama Clay Products Co., Birmingham.
Clyde E. Hagler, V.P., Continental Gin Co., Birmingham.
Vernon Holston, American Cast Iron Pipe Co., Birmingham.
Carl F. Jacks, American Cast Iron Pipe Co., Birmingham.
H. C. McCallum, Melt. Fore., Stockham Pipe Fittings Co., Birmingham.
B. L. Parsons, Mold. Fore., Stockham Pipe Fittings Co., Birmingham.
Edwin H. Phelps, American Cast Iron Pipe Co., Birmingham.
Robert W. Sandelin, Res. Met., Stockham Pipe Fittings Co., Birmingham.
John C. Strickland, Clean. Room Fore., Stockham Pipe Fittings, Birmingham.
L. Hampton Swann, Ind'l. Engr., Stockham Pipe Fittings Co., Birmingham.
M. W. White, Asst. Sec'y., Alabama Clay Products Co., Birmingham.

CENTRAL ILLINOIS CHAPTER

Wm. G. Adams, Pres., Dooley Bros., Peoria, Ill.
Arthur H. Armitage, Prod. Mgr., Dooley Bros., Peoria, Ill.
F. V. Badorek, Fore., Caterpillar Tractor Co., Peoria, Ill.
W. Bornholt, Purchasing, Caterpillar Tractor Co., Peoria, Ill.
P. Buttas, Fore., Caterpillar Tractor Co., Peoria, Ill.
D. A. Colbert, Draftsman, Caterpillar Tractor Co., Peoria, Ill.
A. R. DeGraff, Chemist, Caterpillar Tractor Co., Peoria, Ill.
C. N. Hathaway, Ind. Rel. Dept., Caterpillar Tractor Co., Peoria, Ill.
John Hrvatin, Caterpillar Tractor Co., Peoria, Ill.
Robert J. McCarthy, Fore., South Side Foundry Co., Peoria, Ill.
T. J. McSweeney, Purch. Dept., Caterpillar Tractor Co., Peoria, Ill.
John Palmsino, Alloy Casting Co., Champaign, Ill.
Robert A. Ranney, Fore., Caterpillar Tractor Co., Peoria, Ill.
A. A. Rhodes, Fdy. Supt., Schroeder Foundry & Machine Co., Streator, Ill.
W. Wright, Fore., Caterpillar Tractor Co., Peoria, Ill.
R. Zimmerman, Gen. Fore., Caterpillar Tractor Co., Peoria, Ill.

CENTRAL INDIANA CHAPTER

William M. Calvin, Dir. Train., International Harvester Co., Indianapolis.
Anthony R. Downey, Fore., International Harvester Co., Indianapolis.
Frederic W. Edstrom, Group Leader, International Harvester Co., Indianapolis.
Harrison A. Graber, International Harvester Co., Indianapolis.
Edward I. Jacoby, Asst. Supv. of Safety, International Harvester Co., Indianapolis.
J. Paul Lowe, Asst. Fore., International Harvester Co., Indianapolis.
M. W. McClaskey, Fore., National Malleable & Steel Castings Co., Indianapolis.
Edward L. Resener, Jr., Pttnmkr., C & G Foundry & Pattern Works, Indianapolis.
Chester D. Sears, Asst. Fdry. Met., International Harvester Co., Indianapolis.

CENTRAL OHIO CHAPTER

C. K. Chamberlain, Fdry. Fore., H. B. Salter Mfg. Co., Marysville, Ohio.
Paul D. Frost, Res. Engr., Battelle Memorial Institute, Columbus, Ohio.

CHESAPEAKE CHAPTER

Neville J. Buchanan, Met., Dymonhard Mfg., Roanoke, Va.
William H. Buchanan, Met., Roanoke, Va.
F. P. McDonough, Foundry Rubber, Inc., Washington, D. C.
James A. Mitchell, Sales Mgr., Foundry Rubber, Inc., Washington, D. C.
Stephen W. Richard, Mgr., Richard Machine Works, Norfolk, Va.
James W. Toohey, Pres., Dixie Mfg. Co. Inc., Baltimore, Md.

CHICAGO CHAPTER

Gus Balzweit, Fore., Link Belt Co., Chicago.
John N. Brickman, Field Engr., Norton Co., Chicago.
John Henry Bruhn, Supv. of Mold. Methods, American Steel Foundries, East Chicago, Ind.
Frank Catris, Fore., International Harvester Co., Chicago.
Martin Geo. Dietl, Non-Ferrous Met., Crane Co., Chicago.
Tony Furto, Core Foreman, American Steel Foundries, East Chicago, Ind.
Chester Grelecki, Asst. Gen'l Fore., American Steel Foundries, East Chicago, Ind.
Herbert Madsen, Mgr. Cup. Div., Whiting Corp., Harvey, Ill.
Harold M. McBain, Chief Proposal Engr., Whiting Corp., Harvey, Ill.
John V. McCarthy, Sales Engr., American Smelting & Refining Co., Whiting, Ind.
John Narusevich, Unit Fore., American Steel Foundries, East Chicago, Ind.
Leo C. Ost, Fdry. For., International Harvester Co., Chicago.
Frank Pavlowski, Supt., Precision Match Plate Co., Chicago.
Clay E. Herbst, Jr., Chicago Dist. Engr., Peninsular Grinding Wheel Co., Chicago.
***Precision Match Plate Co., Chicago (Charles J. Balkam, Owner).**
Cecil F. Rowsey, Fdry. Fore., International Harvester Co., Chicago.
L. E. Simon, Ch. Met., Electro Motive Div., General Motors Corp., La Grange, Ill.
***Western Metal Abrasives Co., Chicago Heights, Ill. (Raymond C. Holzman, Mgr.).**
Norman F. Woods, Sales Repr., National Foundry Supply Co., Milwaukee, Wis.

CINCINNATI DISTRICT CHAPTER

V. A. Crainich, Pres. & Treas., Ohio Precision Castings, Inc., Dayton, Ohio.
Russell Cupito, Coremaker, Aluminum Brass Inc., Cincinnati.
William A. McPeek, Mgr., The Peerless Pattern Inc., Dayton, Ohio.
Charles W. Ward, Jr., Met., Lunkenheimer Co., Cincinnati.

DETROIT CHAPTER

Thomas B. Pfaff, Gen. Mgr., Babbitt, Hotchkiss & Co., Sault Ste. Marie, Mich.
L. Ernie Snyder, Fdry. Dept. Mgr., Hickman Williams & Co., Detroit.
Donald J. Unger, Fore., Federal Mogul Corp., Detroit.

EASTERN CANADA & NEWFOUNDLAND CHAPTER

Robert Lepine, Plant Met., Crane Ltd., Montreal, Que.
Albert Robert Thomas, Dominion Engineering Works Ltd., Lachine, Que.

METROPOLITAN CHAPTER

Milton E. Annich, Supt. of Standards, American Brake Shoe Co., New York.
Harry L. Coffey, Fdry. Engr., Coffey Engrg. Co., Westfield, N. J.
Robert J. Ely, Ass't Met., American Brake Shoe Co., Mahwah, N. J.
Francis B. Herlihy, Met. Dept., American Brake Shoe Co., Mahwah, N. J.
Walter L. Kearney, Supv. of Stand., American Brake Shoe Co., Jersey City, N. J.
W. A. Phair, Associate Editor, *The Iron Age*, New York.
B. K. Price, Associate Editor, *The Foundry*, New York.

MEXICO CITY CHAPTER

Ricards de Castro Calvelo, Cia Nacional de Clavos, Mexico D.F.
***Compania Nacional de Clavos, S.A., Mexico, D.F.**
Angel Ronero Corona, Puebla, Pue., Mexico.
Ricardo Meuendez, Col Anahuoc, Mexico City, Mexico.
Luis Fernandez Rivera, Compania Nacional de Clavos, S.A., Mexico D.F.
Roberto Tapia, Cia Constructara de Magumaria, S.A. Mexico, D.F.

MICHIANA CHAPTER

Vic Ankli, Prod. Mgr., Auto Specialties Mfg. Co., St. Joseph, Mich.
Walt. Laltz, Labor Relations, Auto Specialties Mfg. Co., St. Joseph, Mich.
Geo. Adler, Saf. Dir., Auto Specialties Mfg. Co., St. Joseph, Mich.

*Company Members.

NORTHEASTERN OHIO CHAPTER
Milton L. Huemme, Sales., Diamond Alkali Co., Cleveland.
Maurice B. Schramm, Fdry. Inst., Cuyahoga Heights Schools, Cleveland.
Charles J. Terrell, Supt., Apex Electrical Mfg. Co., Cleveland.

NORTHERN CALIFORNIA CHAPTER
Jack DeMello, Molder, Pacific Steel Casting Co., Berkeley, Calif.
*Reliable Pattern Works, San Jose, Calif. (James McEwan, Owner).
J. M. Snyder, Abrasive Engr., Jos. Musto Sons-Keenan Co., San Francisco.

N. ILLINOIS & S. WISCONSIN CHAPTER
Thomas J. Snodgrass, Greenlee Bros. & Co., Rockford, Ill.

NORTHWESTERN PENNSYLVANIA CHAPTER
F. J. Clark, Prod. Mgr., Grove City Brass & Bronze Co., Grove City, Pa.
Howard W. Kelly, Pres. G.M., Grove City Brass & Bronze Co., Grove City, Pa.
Hsiao Tsai-Li, Technician, Cooper-Bessemer Corp., Grove City, Pa.

ONTARIO CHAPTER
R. E. Aitchison, Sand Supv., Dominion Foundries & Steel Co. Ltd., Hamilton, Ont.
Robert A. Campbell, Sales Engr., American Foundry Equipment Co., Mishawaka, Ind.
John Donaldson, Supt. Clean. Rm., Wm. Kennedy & Sons Ltd., Owen Sound, Ont.
Peter Gavens, Fore., Dominion Foundries & Steel Co. Ltd., Hamilton, Ont.
Laurence N. Hansen, Improver, International Harvester Co. Ltd., Hamilton, Ont.
Jos. Louis Masson, Core Dept., Dominion Foundries & Steel Co. Ltd., Hamilton, Ont.
Alex. Pirrie, Plant Mgr., The Gurney Foundry Co. Ltd., Toronto, Ont.
H. S. Powell, Fdry. Fore., The Gurney Foundry Co. Ltd., Toronto, Ont.
Thos. W. Wright, Dominion Foundries & Steel Co. Ltd., Hamilton, Ont.

OREGON CHAPTER
Robert A. Bremner, Asst. Chief Engr., Steel Foundry, Portland, Ore.
J. H. Carter, Engr., Electric Steel Foundry, Portland, Ore.
J. H. Chapman, Prod. Mgr., Western Steel Casting Co., Portland, Ore.
Harry W. Emslie, Pttnmkr., Dependable Pattern Works, Portland, Ore.

PHILADELPHIA CHAPTER
Edward J. Biddle, Asst. Supt., Foran Foundry, Flemington, N. J.
Martin G. Oravec, Foreman, Bethlehem Steel Co., Bethlehem, Pa.
Bart J. Prendergast, Mgr. of Sales Fdy. Div., H. W. Butterworth & Sons, Philadelphia.
Joseph Stockton, Core Supv., Foran Foundry, Flemington, N. J.
Arthur A. Thum, Wks. Mgr., Palmyra Foundry Co., Inc., Palmyra, N. J.

SAGINAW VALLEY CHAPTER
W. R. Baker, Serv. Engr., Albion Malleable Iron, Albion, Mich.
Donald D. Bowman, Office Mgr., The Almont Mfg. Co., Imlay City, Mich.
Frank A. Buike, Personnel Dir., The Almont Mfg. Co., Imlay City, Mich.
Clore D. Chambers, Mech. Engr., General Foundry & Mfg. Co., Flint, Mich.
Keith A. Humbert, Draftsman, Saginaw Malleable Iron Div., General Motors Corp., Saginaw, Mich.
George Arnold Rogers, Supt., The Almont Mfg. Co., Imlay City, Mich.
James K. Walls, Fore., General Foundry Mfg. Co., Flint, Mich.
Paul E. Van Amburg, General Foundry Mfg. Co., Flint, Mich.
Wm. J. Zagrodny, Foreman, General Foundry Co., Flint, Mich.

*Company Members.

ST. LOUIS DISTRICT CHAPTER
John F. Adolphson, Asst. Supt., The Laclede Gas Light Co., St. Louis.
Kenneth Cunningham, Fore., St. Louis Malleable, St. Louis.
John Powell, Asst. Sales Mgr., Federated Metals Div., American Smelting & Refining Co., St. Louis.
Wyman Wills, Repr., American Smelting & Refining Co., St. Louis.

SOUTHERN CALIFORNIA CHAPTER
Frank W. Fawner, Owner, Cast Iron Fittings Co., Los Angeles.
Walter E. Hall, Sales Engr., E. F. Houghton & Co., Los Angeles.
J. J. McCabe, Sales Repr., E. F. Houghton & Co., Los Angeles.
Lloyd D. Reeks, Jr., Salesman, Wilson & George Meyer & Co., Los Angeles.

TEXAS CHAPTER
Jack Barker, Sales Engr., Acme Brick Co., Houston, Tex.
R. H. Glenney, Fdry. Engr., Alamo Iron Works, San Antonio, Texas.
*Elmer O. Rucker, Supt., Worth Mfg. Co. Inc., Fort Worth, Texas.

TOLEDO CHAPTER
Myron E. Boyd, Des. Engr., Albion Malleable Iron Co., Albion, Mich.
*Hillsdale Foundry Co. Inc., Hillsdale, Mich. (W. S. Walters, Pres.)
Superintendent, Hillsdale Foundry Co., Hillsdale, Mich.

TWIN CITY CHAPTER
George S. Olson, Labor Fore., Minneapolis Electric Steel Castings Co., Robbinsdale, Minn.
C. Fred Quest, Asst. Mgr., J. F. Quest Foundry Co., Minneapolis.
W. A. Weber, Sales Engr., American Filter Co., Inc., Minneapolis.

WESTERN MICHIGAN CHAPTER
Lin Shu To, Apprenticeship Training, Campbell Wyant & Cannon Foundry Co., Muskegon, Mich.

WISCONSIN CHAPTER
*Aelco Brass Foundry, Inc., Milwaukee (A. F. Lauerdorf, Pres.)
R. G. Craig, Casting Fore., American Brass Co., Kenosha, Wis.
A. J. Dempsey, Gen. Supt., Crucible Steel Casting Co., Milwaukee.
J. M. Engman, Engman Bros., Milwaukee.
P. B. Iattoni, Asst. Supt., Zenith Foundry Co., West Allis, Wis.
Harry E. Ollenburg, Coreroom Fore., The Pelton Steel Casting Co., Greenfield, Wis.
E. L. Parkman, Milwaukee.
Rudolph S. Pechacek, Time Study Fore., Allis Chalmers Mfg. Co., West Allis, Wis.
Joseph Roman, Supt., Aelco Brass Foundry, Inc., Milwaukee.
Frank G. Seng, Owner, Seng Products Co., Milwaukee.
Erwin G. Tetzlaff, Asst. to Secy., The Pelton Steel Casting Co., Milwaukee.
C. F. Vandenberg, Sales Mgr., Anderson Laboratories, Milwaukee.
Fay D. Walrath, Prop., F & W Pattern Works, Milwaukee.
Ken Withey, Pattern Supt., Crucible Steel Casting Co., Milwaukee.

OUTSIDE OF CHAPTER
Chester M. Adams, Mgr. Alloy Dept., Latrobe Electric Steel Co., Latrobe, Pa.
Cherwood Chiang, Mech. Engr., Chinese Supply Commission, Washington, D. C.

France
Jean Jaques Baron, Chief Engr., L'Aluminum Francais, Paris, France.
Andre Mercier, Ingenieur en Chef, Schneider of Compagnie, Paris, France.

Holland
N. V. de Battafsche Petroleum Mij., Laboratorium, Amsterdam, Holland.

India
Messrs. Mukand Iron & Steel Works, Ltd., c/o Balkrishna Book Co., Lahore, India.

Industrial Trends In Eye Testing Methods

IMPROVED METHODS for testing visual acuity, through which applicants who might formerly have been screened out entirely are placed in jobs for which they are visually competent, are described in one section of a study, "Methods of Testing and Protecting Eyesight in Industry," prepared by the Industrial Health Section of the Metropolitan Insurance Company.

Procedure for setting up an industrial eye testing program is given, and various techniques are described. The discussion is illustrated with testing charts and record forms.

A copy of this study is available to executives who request it on their business stationery, from: Policy Holders Service Bureau, Metropolitan Life Insurance Company, 1 Madison Ave., New York 10.

Gray Iron Members To Talk Metal Properties

THE STEERING COMMITTEE, A.F.A. Gray Iron Division, met in Cleveland, February 7, at the Statler Hotel. Under the chairmanship of T. E. Eagan, Cooper-Bessemer Corp., Grove City, Pa., committee members discussed details of the gray iron sessions and the gray iron shop course to be held at the 50th Anniversary Foundry Congress and Foundry Show at Cleveland, May 6-10.

Two of the convention sessions will be devoted to engineering properties of gray iron. Engineers are being invited to attend these meetings to determine whether or not the information presented is the type desired for engineering handbooks. A number of papers of general interest to gray iron foundrymen have been secured for presentation at the convention.

For the gray iron shop course, papers dealing with the metallurgy of cupola mixtures and carbon control in the cupola have been secured. Also on the shop course program are papers dealing with defects in gray iron castings.

FOUNDRY PERSONALITIES

Charles S. Reed, Jr., has been elected president and general sales manager, Chicago Retort & Fire Brick Co., Chicago. Mr. Reed is vice-chairman of the A.F.A. Refractories Committee. **Carl Von Luhrte,** chairman, Quad City chapter, has been transferred from Davenport, Iowa, to Chicago, and has been made sales manager, western division. **Robert P. Stevens** has been made sales manager, eastern division.

Harold Walsh, president and general manager, The Lectromelt Steel Casting Co., Barberton, Ohio, announced that The Lectromelt Steel Casting Co. and The Barberton Foundry Co., both of Barberton, have merged under the name of The Lectromelt Casting Co.

James Gerity, Jr., president, Gerity-Adrian Mfg. Co., Adrian, Mich., and **Louis W. Blauman,** president, Michigan Die Casting Co., Detroit, have announced the approval of their respective company officers and directors to merge the two concerns. Stockholders will vote upon ratification of the agreement.

Edgar L. Newhouse, Jr., president, Federated Metals Div., American Smelting & Refining Co., New York, has announced completion of arrangements with the Gardiner Metal Co., Chicago, to produce and market Gardiner extruded solders. **Harry Gardiner, Harold Gardiner** and **James C. Shaw,** who had directed these operations for the Gardiner Company, will serve Federated customers under the new arrangement.

Antonia Lage, owner, Usina Sta. Eugenie, Rio de Janeiro, Brazil, and an A.F.A. member, was a visitor at the National Office recently.

Philippe Delachaux, president, Acieries de Gennevilliers at Gennevilliers, Siene, France, was recently a visitor in the A.F.A. office. Mr. Delachaux, a member of the A.F.A., operates a steel foundry in his home town. He is visiting in this country, gathering information on developments in the steel foundries during the war.

William D. Todd has been appointed assistant to the president of Aetna-Standard Engineering Co., Youngstown, Ohio.

E. C. Hoenicke

Max Kuniansky

Edward C. Hoenicke, general manager, Foundry Div., Eaton Mfg. Co., Detroit, and Chairman, Detroit chapter, A.F.A., has been appointed a member of the Gray Iron Foundry Industry Advisory Committee to the Army Industrial College, Washington, D. C.

Max Kuniansky, Lynchburg Foundry Co., Lynchburg, Va., a National A.F.A. Director, delivered an address before the annual convention of the Institute of Scrap Iron & Steel which was held in Chicago.

W. W. Coutts

William W. Coutts, formerly assistant secretary, National Screw Machine Products Assn., Cleveland, has assumed the position of executive vice president, Gray Iron Founders' Society, succeeding **W. W. Rose** who retired because of ill health.

Rene Kenner, managing director, S.O.F.A.L., Paris, France, was a recent National office visitor.

M. D. Johnson, recently on the staff of the Director of Manufacturing, Graham-Paige Motors Corp., Detroit, has been appointed factory works manager, Purolator Products, Inc., Newark, N. J.

Mr. Johnson was the first chairman of the A.F.A. Committee on Inspection of Castings.

Carl H. Morken, formerly associated with Carondelet Foundry Co., St. Louis, is now affiliated with Centrifugal Casting Co., Inc., Bluffton, Ind., as executive general superintendent.

R. W. Batchelder

C. H. Morken

Robert A. Parks has been named general sales manager of the Jessop Steel Company, Washington, Pa., according to announcement by **T. W. Pennington,** vice-president in charge of sales.

Roger W. Batchelder has been appointed general purchasing agent, American Brake Shoe Co., Mahwah, N. J., replacing **William T. Kelly, Jr.,** now president of the company's Kellog Division.

Dr. R. M. Brick, formerly associated with Yale University, New Haven, Conn., has joined the University of Pennsylvania, Philadelphia, as professor of metallurgy, and is organizing a new department

of graduate and undergraduate study, as well as a laboratory for fundamental research. Dr. Brick is a member of the Committee on Microstructure of Brass and Bronze Alloys, A.F.A. Brass and Bronze Division.

R. H. Dahlberg has accepted an assistant professorship at Oregon State College, Corvallis, Ore., where he will teach foundry practice. Recently discharged after two years in the navy, he was a lieutenant aboard a destroyer escort and saw service in the Atlantic, Pacific and Mediterranean.

Nelson F. Wilmot has been appointed Chicago District sales manager and **Merle S. Clark** becomes St. Louis District sales manager, The Mathieson Alkali Works, according to an announcement from **G. W. Dolan,** company president. Mr. Clark will be in charge of the newly opened St. Louis branch office in the Paul Brown Building.

J. F. Bork, recently released by the Navy where his duties were concerned with job evaluation, wage classification and work standards, has joined the staff of Lester B. Knight & Associates, Chicago, as junior engineer. Mr. Bork is a member of the Wisconsin chapter, A.F.A., and of AIME.

A. H. Hesse, who has specialized in the control, production and development of copper-base alloys in his associations in private industry, has joined the metallurgical engineering staff of R. Lavin & Sons, Inc., Chicago. Graduate of Missouri School of Mines and Metallurgy, Rolla, Mo., and author of a number of technical papers, Mr. Hesse is a member of the Chicago chapter, A.F.A., and has served as head of the non-ferrous alloy section, Naval Research Laboratory, Washington, D. C., and as a research metallurgist with Battelle Memorial Institute, Columbus, Ohio.

John Bacon, John A. Foster, Lloyd A. Reeks, Jr., George W. Vaughan and **Ralph S. Waltz** after serving with the armed forces have become associated with Wilson & Geo. Meyer & Co. Mr. Bacon and Mr. Waltz have been assigned to the San Francisco office while Mr. Reeks and Mr. Vaughan will make Los Angeles their headquarters. Mr. Foster will be in the Seattle office.

N. F. Wilmot

H. L. LeMay

Henry L. LeMay has been named manager, Chicago office and warehouse, Bay State Abrasive Products Co., Westboro, Mass.

M. E. Nevins

Merle S. Clark

M. E. Nevins, formerly with Ampco Metal, Inc., Milwaukee, is one of the principals in formation of Whitewater Centrifugal Casting Co., Whitewater, Wis.

Donald L. Colwell, recently discharged from the Army Air Forces, U. S. Strategic Bombing Survey, is now associated with The National Smelting Company, Cleveland.

Charles E. Andrews after serving 25 years as a director and New England manager, Whitehead Bros. Co., New York, has retired. He also has been an employee over 41 years. **F. B. Clark** has been appointed to fill Mr. Andrews' position as manager.

John F. Smith, Chevrolet Gray Iron Division, General Motors Corp., Saginaw, Mich., formerly Vice-Chairman of the Saginaw Valley Chapter, has been elected Chairman to fill the unexpired term of **H. G. McMurry.** As reported in a recent issue of AMERICAN FOUNDRYMAN, Mr. McMurry has sailed for Australia, for General Motors Overseas Unit, where he will build and operate a new malleable foundry in Melbourne.

M. F. Becker & Associates, Chicago, have been appointed sales representatives for the Alvey-Ferguson Co., Cincinnati, manufacturers of conveying and metal cleaning and finishing equipment.

Howard N. Verrault, recently discharged from the U. S. Navy, will be connected with Velsicol Corp. and will be with that company's Eastern offices at 11 Park Place, New York.

D. Polderman, Jr., Whiting Corp., New York, has been named Treasurer, A.F.A. Metropolitan chapter, succeeding **H. B. Caldwell,** of the same firm, who has been transferred to the Swenson Division as state sales manager.

Obituaries

Sidney Curtis Vessy, president, W. W. Sly Mfg. Co., Cleveland, and member of the A.F.A. Board of Directors 1926-28, died at his home in Cleveland, Thursday, Feb. 4.

S. C. Vessy

From the time of its organization he was an active member of the Foundry Equipment Manufacturers Association, Cleveland, and served as President in 1933 and 1934.

George Fuller, Federal Foundry Supply Co., Detroit, who had been elected Secretary of the Detroit chapter to fill the unexpired term left by the resignation of Howard H. Wilder, died suddenly at his home on Tuesday, February 26.

★ CHAPTER ACTIVITIES ★

news

Canton District

Nils E. Moore
Wadsworth Testing Laboratory
Chapter Reporter

HOLDING ITS January 10 meeting at the Massillon Club, Massillon, Ohio, the Canton District chapter heard Adrian C. Den Breejen, Hydro-Blast Corp., Chicago, present an illustrated discussion of "Practical Foundry Sand Problems."

The speaker accompanied his remarks, on the chemical and physical aspects of sand, with lantern slides that contributed to a clear understanding of the factors under consideration. His discussion, designed to make the members more sand-conscious, also considered particle size and its relation to permeability and tensile strength.

Wisconsin

UNDER THE joint sponsorship of the A.F.A. Wisconsin chapter and the University of Wisconsin, Madison, the Ninth Annual Regional Foundry Conference was held at the Hotel Schroeder, Milwaukee, February 7-8.

The series of 22 technical sessions presented valuable information on subjects of vital importance to foundrymen, and commanded the enthusiastic interest of those attending. As an instance, the total attendance for the four meetings of the pattern group was 440, and the discussions were marked by the participation of a high percentage of those present.

V. J. Sedlon, Master Pattern Co., Cleveland, Vice-Chairman of the A.F.A. Patternmaking Division, addressed the second meeting of the pattern group, Thursday, February

Overall view of banquet scene in the Terrace of the Tutwiler Hotel, Birmingham, Ala. The event climaxed the Fourteenth Annual Foundry Practice Conference.

CHAPTER MEETINGS

MARCH-APRIL

March 19
Twin City
Curtis Hotel, Minneapolis
FRANK ROSS
E. F. Houghton & Co.
"Lubrication and Maintenance Problems in a Foundry"

March 20
Connecticut Non-Ferrous Foundrymen's Association

Northwestern Pennsylvania
Grove City, Pa.
T. E. EAGAN
Cooper-Bessemer Corp.
"Metallurgy of Gray Iron"

March 21
Detroit
Rackham Educational Memorial
J. E. LINABURY
General Motors Corp.
W. N. WITHERIDGE
Detroit Bureau of Industrial Hygiene
"Control of Dust and Fumes—Sources, Control, Methods and Equipment"

Canton District
Mergus Restaurant, Canton
F. G. SEFING
International Nickel Co.
"Molding Methods for Sound Castings"

March 22
Birmingham District
Tutwiler Hotel, Birmingham, Ala.
PANEL DISCUSSION

March 25
Central Ohio
Chittenden Hotel, Columbus
DR. J. A. RIDDERHOF
Frederic B. Stevens, Inc.
"Core and Mold Coatings"

Northwestern Pennsylvania
Moose Club, Erie
DR. R. L. LEE
General Motors Corp.
"Industrial Relations"

March 29
Chesapeake
Engineers Club, Baltimore, Md.
R. J. COWAN
Surface Combustion Co.
"Moisture Control in Foundry Operations"

Ontario
Royal Connaught Hotel, Hamilton
G. A. HOWARD
Canadian National Railways
"Apprentice Training"

April 1
Central Indiana
Athenæum, Indianapolis
A. K. HIGGINS
Allis Chalmers Mfg. Co.
"Correlation of Metallurgical Information and Foundry Properties of Non-Ferrous Alloys"

Chicago
Chicago Bar Association
ROUND TABLE MEETING

April 2
Michiana
Hotel La Salle, South Bend, Ind.
J. A. GITZEN
Delta Oil Products Co.
"Mold and Core Coatings"

April 4
Saginaw Valley
Fischer Hotel, Frankenmuth, Mich.
DR. C. R. AUSTIN
Meehanite Metal Corp.
"Heat Treatment of Iron Castings"

April 5
Western New York
Hotel Touraine, Buffalo
J. H. LANSING
Malleable Founders Society
"Malleable Iron"

April 8
Cincinnati District
Engineering Society Headquarters
Cincinnati
J. B. CAINE
Sawbrook Steel Castings Co.

April 9
Rochester
Hotel Seneca

April 11
Texas
Lufkin, Texas
L. P. ROBINSON
Werner G. Smith Co.
"Core Room Variables"

Northeastern Ohio
Cleveland Club
DR. PAUL F. COLLINS
Austenal Laboratories, Inc.
"Precision Castings"

APRIL 12
Northern California
Engineers Club, San Francisco

Philadelphia
Engineers Club
CLYDE L. FREAR
U. S. Navy Department
"Casting Defects and Their Remedies"

Eastern Canada & Newfoundland
Mt. Royal Hotel, Montreal
GROUP MEETINGS

Wisconsin
Hotel Schroeder, Milwaukee
SECTIONAL MEETING

April 18
Twin City
Curtis Hotel, Minneapolis
G. K. DREHER
Ampco Metal, Inc.
"The Use of Bronze"

Canton District
Mergus Restaurant, Canton
ROUND TABLE MEETING

Detroit
Rackham Educational Memorial
ROUND TABLE MEETING

April 19
Toledo
Toledo Yacht Club

April 22
Central Ohio
Fort Hayes Hotel, Columbus
J. A. KAYSER
Laclede-Christy Clay Products Co.
"Foundry Refractories"

8, on the subject of "Permanent Molds." Chairman of the pattern program was A. F. Pfeiffer, Allis-Chalmers Mfg. Co., Milwaukee.

"Future Foundrymen" was the subject of A.F.A. National President Fred J. Walls, International Nickel Co., Detroit, who addressed the luncheon meeting of Friday, Febru-

(Photos courtesy John Bing, A. P. Green Fire Brick Co.)

Wisconsin Regional Conference leaders: Co-Chairman R. J. Anderson (left), Belle City Malleable Iron Co., Racine, Wis.; and Chairman D. C. Zuege, Sivyer Steel Casting Co., Milwaukee.

ary 8. Conference Chairman D. C. Zuege, Sivyer Steel Casting Co., Milwaukee, vice-president of the Wisconsin chapter, presided.

Chapter Chairman John Bing, A. P. Green Fire Brick Co., Milwaukee, presided at the general meeting that opened the conference Thursday morning, and also at the banquet Thursday evening.

Western New York

L. A. Merryman
Tonawanda Iron Corp.
Chapter Secretary

DRAWING AN ATTENDANCE of more than 300 members and guests, the Annual Stag Party of the Western New York chapter was held at the Elks Club, Buffalo, N. Y., Saturday evening, January 19. A buffet supper was followed by a floor show under the direction of Edwin W. Deutschlander, Worthington Pump & Machinery Corp., Harrison, N. J., and his entertainment committee; and the event was adjudged a great success by those present.

Metropolitan

DESIGNED FOR apprentice and manager alike, the annual lecture course of the A.F.A. Metropolitan chapter will concern "Fundamental Studies of Foundry Sands," and will

(Photo courtesy John Bing, A. P. Green Fire Brick Co.)

Fred Gregg, Whiting Corp., Harvey, Ill., (third from left) seemed to have a discussion started at the Wisconsin Regional Conference Banquet.

(Photos courtesy John Bing, A. P. Green Fire Brick Co.)

National President Fred J. Walls (second from left), International Nickel Co., Detroit, who addressed the Wisconsin Regional Conference, with past National Director B. D. Claffey (left), General Malleable Corp., Waukesha, Wis.; and Wisconsin Chapter Director H. E. Ladwig, Allis-Chalmers Mfg. Co., Milwaukee. Right: W. A. Hambley, Allis-Chalmers Mfg. Co., Chairman, Committee on Analysis of Casting Defects, Gray Iron Division, who spoke before one of the gray iron sessions.

(Photo courtesy John Bing, A. P. Green Fire Brick Co.)

National Director G. K. Dreher (left), Ampco Metal, Inc., Milwaukee; conference General Program Chairman R. C. Woodward, Bucyrus Erie Co., Milwaukee; and Dr. J. T. MacKenzie, American Cast Iron Pipe Co., Birmingham, Ala., member Executive Committee, Gray Iron Division, who reported on German centrifugal casting to the Wisconsin Regional Conference

(Photo courtesy John Bing, A. P. Green Fire Brick Co.)

Past Chapter Chairmen, Wisconsin chapter, gather at the Wisconsin Regional Conference. Left to right: National Director Roy M. Jacobs, Standard Brass Works, Milwaukee; W. F. Bornfleth, Cutler-Hammer, Inc., Milwaukee; W. H. Gerlinger, W. H. Gerlinger, Inc., Milwaukee; A. C. Ziebell, Universal Foundry Co., Oshkosh, Wis.; Chapter Director H. E. Ladwig, Allis-Chalmers Mfg. Co., Milwaukee; National Director G. K. Dreher, Ampco Metal, Inc., Milwaukee; and past National Director B. D. Claffey, General Malleable Corp., Waukesha, Wis.

be held at Newark College of Engineering, Newark, N. J., on four consecutive Wednesday evenings, March 20 and 27, April 3 and 10.

Lecturers for the sessions will be W. F. Rose, Smith Oil & Refining Co., Rockford, Ill., and G. F. Watson, American Brake Shoe Co., Mahwah, N. J., a member of the A.F.A. Core Test Committee.

The course outline indicates a very comprehensive treatment of the subject matter, from an introductory consideration of types of mold materials through binders, additions, mixing and aerating, drying, core oils and core baking, reinforcement of cores, and numerous other aspects of sand technology.

Arrangements for the lecture course are in charge of the chapter educational program committee under the chairmanship of K. A. DeLonge, International Nickel Co., Inc., New York. R. Maddison, Whitehead Bros Co., New York, co-chairman of publicity for the committee, is handling registration.

Central New York

John A. Feola
Crouse-Hinds Co.
Chapter Reporter

ONE OF THE PIONEERS in the investment molding field, Harold P. Gray, Gray Mfg. Co., Syracuse, N. Y., presented the subject, "Precision Castings," before the Central New York chapter at its February 8 meeting. The meeting was held at the Onondaga Hotel, Syracuse, N. Y., with Chapter Vice-President E. E. Hook, The Dayton Oil Co., Syracuse, presiding.

A great deal of interest in the subject, sometimes referred to as "the lost wax process," was shown by the members, and Mr. Gray was called upon to answer numerous questions at the conclusion of his talk. A number of specimens presented by the speaker, including wax patterns, molds in various stages of production, and castings both gated and finished, were especially interesting to those present.

In his discussion Mr. Gray traced the history of the process from the time of Cellini in the 15th century, through its use in dental laboratories and the manufacture of jewelry, and its recent industrial applications beginning in the early days of World War II.

He pointed out both the advantages inherent in the method through which intricate shapes can be cast and close tolerances maintained, and the limitation of size, a mold of several pounds being the capacity at present.

Central Ohio

K. W. Whitlatch
Aetna Firebrick Co.
Chapter Secretary

ROUND TABLE DISCUSSIONS of iron, steel, and non-ferrous metal casting were held by the Central Ohio chapter at the Fort Hayes Hotel, Columbus, Ohio, January 28. Maj. Norman A. Irmie, Columbus, gave a humorous after-dinner talk before the meeting was divided into sections.

Leaders for the round table groups were: R. H. Frank, Bonney-Floyd Co., Columbus, steel; Dave Whyte, Cooper-Bessemer Corp., Mt. Vernon, Ohio, iron; and Dr. L. W. Eastwood,

(Photo courtesy George F. Pettinos, Inc., Philadelphia.)

Speakers' table, annual banquet of the Metropolitan chapter. Left to right: Chapter Director Alexander McIntosh, Wright Aeronautical Corp., Paterson, N. J.; M. J. Hogan, Bierman Everitt Foundry Co., Irvington, N. J., President, New Jersey Foundrymen's Association; Chapter Director and Entertainment Committee Chairman D. S. Yeomans, George F. Pettinos, Inc., East Orange, N. J.; and Chapter Chairman H. A. Deane, American Brake Shoe Co., New York.

A view of the banquet which climaxed the first day of the Ninth Annual Regional Foundry Conference sponsored by the Wisconsin chapter.

Battelle Memorial Institute, Columbus, Ohio, non-ferrous.

The doing away with vents in sand molds for steel castings was a subject of considerable interest to the steel round table, with one steel producer reporting that favorable results had been obtained with experiments made in this regard. Also raised was the question of graphitization of abnormal steels at high temperatures, and the possibility that specifications prohibiting the use of aluminum in steels for high temperature use may be issued. This point was followed by consideration of alternate deoxidation practices.

Central Indiana

B. P. Mulcahy
Citizens Gas & Coke Utility
Chapter Historian

DRAWING FROM his wide experience on the subject, Dr. R. L. Lee, General Motors Corp., Detroit, addressed the January 7 meeting of the Central Indiana chapter on "Leadership and What It Takes."

Dr. Lee stressed the importance of the art of humanics, which he declared is sadly neglected in industry, although it may often prove the deciding factor in the overall economic picture of an organization.

Chapter Director William Ziegelmueller, Electric Steel Castings Co., Indianapolis, served as technical chairman of the meeting.

Twin City

Paul Hesse
Union Brass & Metal Mfg. Co.
Chapter Reporter

THE JANUARY meeting of the Twin City chapter was held at the American Hoist & Derrick Co., St. Paul, Minn., with H. M. Patton acting as host. An excellent meal was provided by the plant kitchen and served in the company's new lunch room. Chapter Chairman R. C. Wood, Minneapolis Electric Steel Castings Co., Minneapolis, presided over the meeting.

The technical speaker was Adrian C. Den Breejen, sand technician, Hydro Blast Corp., Chicago. The speaker emphasized the chemical and physical properties of sand and explained their relationship to casting quality. He outlined the lack of a basic understanding of foundry sand, the disregard of simple sand tests, and the lack of application of the results of standard sand tests, as causes of sand problems in the foundry.

Mexico City

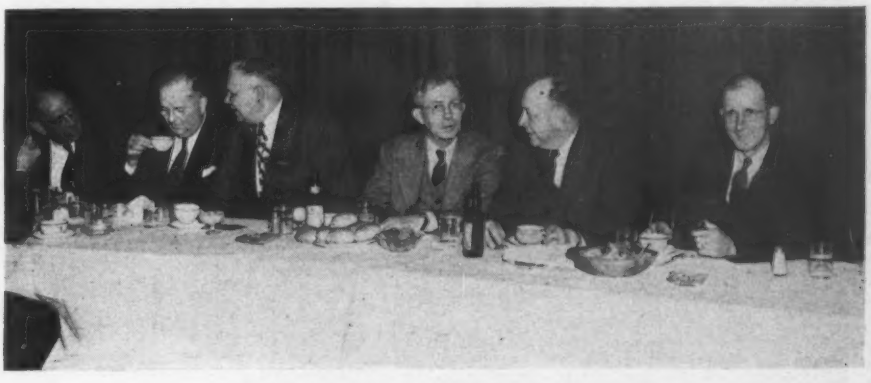
N. S. Covacevich
Casa Covacevich
Chapter Secretary

FORMAL ELECTION, the first for this thirty-second A.F.A. chapter, was held by the Mexico City group at its meeting of January 4, 1946.

Officers and directors chosen were: *President,* Ing. Ernesto Villalobos, Compañía Constructora Maquinaria; *Vice-President,* Ing. Manuel Goicochea, Fundiciones Hierro y Acero, S. A.; *Secretary,* N. S. Covacevich, Casa Covacevich, Foundry Supplies & Equipment; *Treasurer,* Ing. González Vargas, consulting metallurgist; *Directors,* Ing. E. Macías Sauza, Fundiciones y Talleres America; John Schendel, La Consolidada, S. A.; Ing. Ricardo Menendez; F. González Mena; Ing. Secundino Ruiz, Hierro Maleable de México; and Ing. Flavio Castillo, Maquinaria y Mecanismos.

Future activities of the Mexico City chapter were discussed at the February 1 meeting, and a number of projects were decided upon as methods of rendering practical assistance to foundrymen.

The first step in this program will be to send a circular to all foundries



(Photo courtesy B. P. Mulcahy, Citizens Gas & Coke Utility.)

Speaker's table at the January meeting of the Central Indiana chapter. Left to right: L. C. Snyder, Hickman, Williams & Co., Cincinnati; H. C. Rogers, of the same firm; Chapter Chairman R. S. Davis, National Malleable & Steel Castings Co., Indianapolis; Dr. R. L. Lee, General Motors Corp., Detroit, speaker of the evening; William Ziegelmueller, Electric Steel Castings Co., Indianapolis, technical chairman of the meeting; and Chapter Vice-Chairman J. P. Lentz, International Harvester Co., Indianapolis.

in Mexico, inviting foundrymen to join the chapter and requesting information in regard to the foundries themselves, their capacity, class of work, etc. This latter information will be used in the preparation of a directory.

Also considered was preparation of the first chapter publication, which will be in the form of a small folder, containing all information which the members possess in regard to the materials available for foundry use in Mexico.

(Photos courtesy Sterling Farmer, Sand Products Corp.)

Some views of the large and enthusiastic groups at the Northeastern Ohio chapter Christmas party.

Connecticut Non-Ferrous

Louis G. Tarantino
Niagara Falls Smelting & Refining Corp.
Association Secretary

DISCUSSING THE SUBJECT of "Carbon and Graphite Electrodes," before the Connecticut Non-Ferrous Foundrymen's Association, January 16, at the Hotel Taft, New Haven, Conn., A. B. Oatman and S. P. Uhl, National Carbon Co., New York, presented a sound and color motion picture illustrating production of the two materials and the manufacture of various shapes.

Carbon and graphite products for metallurgical and foundry use, such as electrodes, crucibles, furnace linings, molds, mold plugs and chills, were described by the speakers. The application of graphite rods in blind, semi-blind and open risers to produce shrinkage in the riser and increase metal flow, also was discussed.

During the question period, the speakers were called upon to comment upon such aspects as: electrode consumption per ton of brass melted, adjustment of electrodes to prolong life, electrode losses with covered and uncovered melts of monel metal in electric furnaces, effect of dampness on electrode life and the performance of soft or porous electrodes.

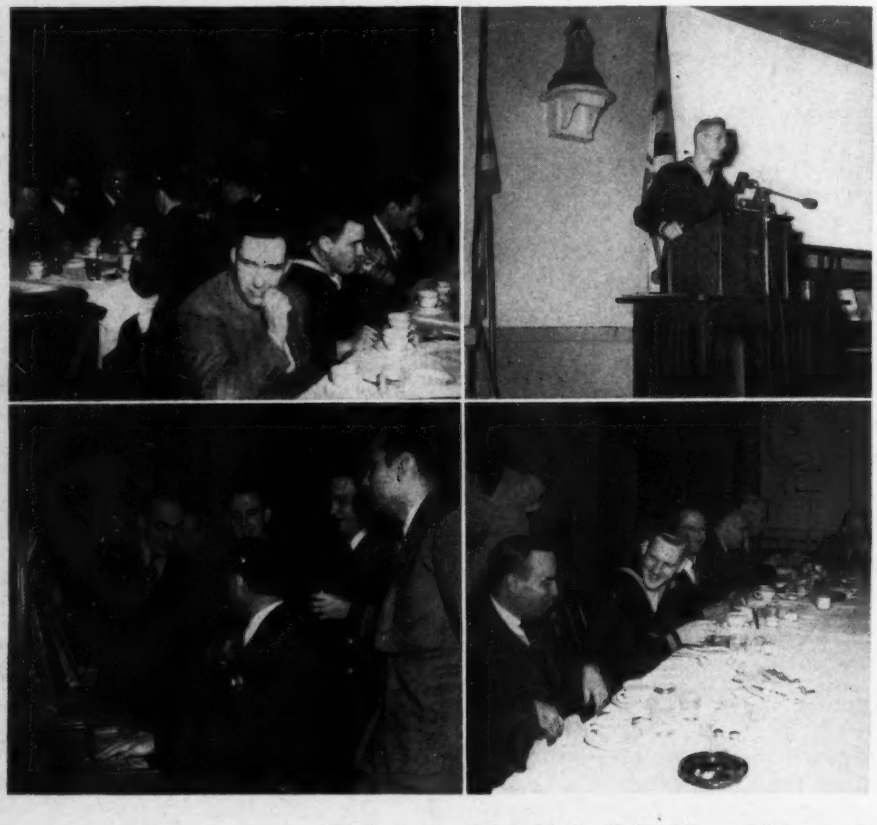
Chesapeake

Lt. J. T. Robertson, USNR
Naval Research Laboratory
Chapter Reporter

VERY STRIKING advantages obtainable through the use of insulating materials to facilitate directional solidification in non-ferrous castings were detailed to the Chesapeake chapter at its regular monthly meeting, January 25, Engineers' Club, Baltimore, Md. William C. Wick, Naval Research Laboratory, Washington, D. C., whose topic was "The Use of Insulating Material for Producing Bronze Castings" did the detailing.

> For the material upon which Mr. Wick drew for this address, see the paper by W. C. Wick and H. F. Taylor, which appears in this issue.

In the discussion period that followed, Chapter Vice-Chairman David Tamor, American Chain & Cable Co., York, Pa., J. E. Crown and Earl Bush, U. S. Navy Yard, Washington, D. C., and E. T. Myskowski and Dick Wynne, Naval Research Laboratory, contributed their comments on this subject.



(Photos courtesy of E. T. Myskowski, Naval Research Laboratory.)

At the January meeting of the Chesapeake chapter. William C. Wick (upper right), Naval Research Laboratory, Washington, D. C., describes the use of insulating material in the production of bronze castings.

Michigan State

SPONSORED JOINTLY by the Saginaw Valley, Michiana, Detroit and Western Michigan A.F.A. chapters in cooperation with the School of

Right—The R. E. Olds Hall of Engineering, Michigan State College, in which the Regional Foundry Conference will meet.

Engineering, Michigan State College, East Lansing, the Annual Regional Foundry Conference will be held at the college Friday and Saturday, April 5-6.

National A.F.A. President Fred J. Walls will discuss "Attracting and Holding Foundry Workers" before the Saturday morning session. A.F.A. Gold Medalist Carl F. Joseph, Saginaw Malleable Iron Div., General Motors Corp., Saginaw, Mich., a member of the Executive and Program and Papers committee, Malleable Division, will address the delegates on "Recent Developments in Making Malleable Castings."

Chairman of the Arrangements Committee is C. C. Sigerfoos, Associate Professor, Department of Mechanical Engineering, Michigan State College. Other members of the committee are: Chapter Chairman J. F. Smith, Chevrolet Gray Iron Div., General Motors Corp., Saginaw, Mich., representing the Saginaw Valley chapter; M. F. Surls, Clark Equipment Co., Buchanan, Mich., representing the Michiana chapter; F. A. Wagner, Centrifugal Fusing Co., Lansing, Mich., representing the Detroit chapter; and R. W. Hathaway, representing the Western Michigan chapter.

In addition to Chairman Sigerfoos, Michigan State College is represented by H. B. Dirks, Dean of Engineering, and H. Womochel, research assistant.

The conference program is shown in the adjoining box.

Michigan State Regional Conference
April 5-6
Michigan State College
E. Lansing, Mich.

Friday, April 5

9:30 am—Address of Welcome
Speaker, Prof. L. G. Miller, Head, Mechanical Engineering Dept., Michigan State College.

10 am—Foundry Control
Speaker, H. W. Dietert, Harry W. Dietert Co., Detroit.
"Foundry Control Methods and How They Save Money"

11 am—Precision Casting
Speaker, W. A. Morey.
"Precision Castings"

2 pm—Cast Iron
Speakers, H. Womochel and C. C. Sigerfoos, Research Assistant and Associate Professor, respectively, Michigan State College.
"Relative Effect of Lime and Dolomite Fluxes on Cupola Irons and Cupola Operations"

3 pm—Malleable
Speaker, C. F. Joseph, Saginaw Malleable Iron Div., General Motors Corp., Saginaw, Mich.
"Recent Devolopments in Making Malleable Castings"

4 pm—Steel
Speaker, H. F. Taylor, Naval Research Laboratory, Washington, D. C.
"Control of Steel Casting Defects"

7 pm—Conference Dinner

Saturday, April 6

9 am—Personnel
Speaker, National President F. J. Walls, International Nickel Co., Detroit.
"Attracting and Holding Foundry Workers"

Saturday (Cont.)

9:30 am—Training
Speaker, H. B. Dirks, Dean of Engineering, Michigan State College.
"College Training of Foundry Engineers"

10 am—Hygiene
Speaker, Dr. Markuson, Director, Bureau of Industrial Health, Michigan State Dept. of Health, Lansing.
"Foundry Health Hazards"

11 am—Non-Ferrous
Speaker, M. E. Brooks, Dow Chemical Co., Bay City, Mich.
"The Casting of Magnesium Base Alloys"

1:30 pm—Patternmaking
Speaker, F. C. Riecks, Ford Motor Co., Dearborn, Mich.
"Modern Trends in Pattern Rigging for Production Molding"

2:30 pm—Cast Iron
Speaker, Prof. O. W. Boston, Chairman, Dept. of Metal Processing, University of Michigan, Ann Arbor.
"Some Results Obtained on the Nature of Tool Wear and Power Required When Milling Various Types of Cast Iron"

3:30 pm—Gray Iron
Speakers, C. C. Sigerfoos and H. Womochel.
"Effect of the Mold on Cavity Defects in Gray Iron Castings"

Texas

R. H. Glenney
Alamo Iron Works
Chapter Reporter

MEETING IN THE Plaza Hotel, San Antonio, January 24, the Texas chapter heard National Director F. M. Wittlinger, Texas Electric Steel Casting Co., Houston, Texas, discuss the forthcoming 50th Anniversary Foundry Congress to be held in Cleveland, May 6-10, and Harry Linderman, Dallas office, Lacklede-Christy Clay Products Co., present a technical paper, "Properties of Refractories."

Mr. Wittlinger reported that the Congress is expected to surpass in interest and size any previously held, and urged those present to attend and make early reservations. He also discussed the AMERICAN FOUNDRYMAN, official publication of the

A.F.A., pointing out recent improvements and plans for still further improvements and the publication of new and important articles of interest to the industry.

Mr. Linderman's paper, which presented a review of basic refractories, was followed by a discussion in which particular interest was evinced in connection with cupola linings. In this regard, the speaker pointed out that it is generally considered economical to use fire clay patching in the melting zone until the lining further up needs replacing.

Chapter Chairman E. P. Trout, Lufkin Foundry & Machine Co., Lufkin, Texas, expressed thanks to Chapter Vice-Chairman W. M. Ferguson, Texas Electric Steel Casting Co., Houston, who acted as program chairman, and Chapter Directer W. J. Temple, Kincaid-Osborn Electric Steel Co., Inc., San Antonio, for their contributions to the success of the meeting.

Cincinnati District

Wm. H. Hoppenjans, Jr.
Star Foundry Co.
Chapter Secretary

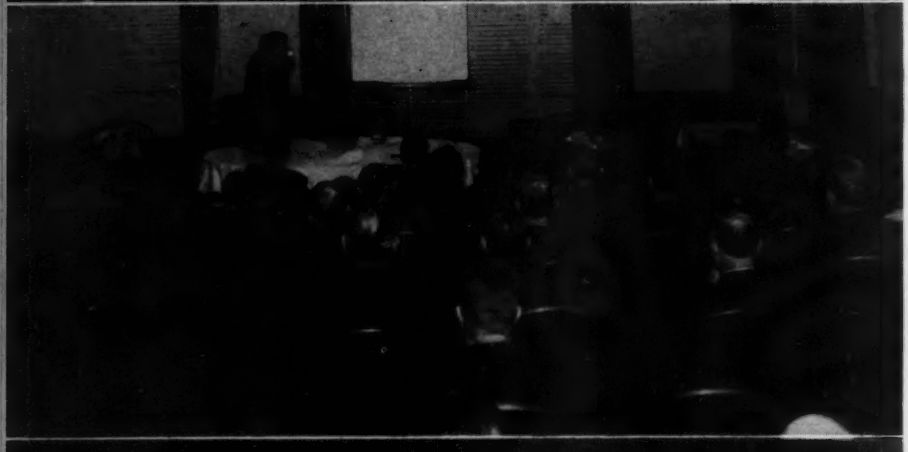
PRINCIPAL SPEAKER at the February 11 meeting of the Cincinnati District chapter was William B. George, R. Lavin & Sons, Chicago, who spoke on "Brass and Bronze Castings."

The meeting was held at the Engineering Society Headquarters, Cincinnati, and approximately 85 members and guests were in attendance. Mr. George directed his remarks toward the clarification of the principle of directional solidification, and shrinkage prevention in brass and bronze castings.

A large delegation of students and faculty members from Withrow High School, Cincinnati, were at this meeting as guests of the chapter.

Scenes at the December meeting of the Northern California chapter. J. C. Glidewell (center photo, at the screen), Hall Scott Motor Car Co., Berkeley, Calif., was the speaker of the evening.

(Photos courtesy Bernard DeRochie, Western Machinery & Steel World.)



Eastern Canada-Newfoundland

G. D. Turnbull
Shawinigan Foundries Ltd.
Chairman, Publicity Committee

THE SECOND GROUP discussion meeting sponsored by Eastern Canada and Newfoundland chapter brought out a record crowd for the February 8 meeting held at the Mt. Royal Hotel, Montreal.

The group broke up into three sections, discussing iron and steel, non-ferrous and miscellaneous subjects.

Chairman of the iron and steel session was J. Grieve, Dominion Engineering Works Ltd., Lachine, Que. Discussion leaders were William Bradley, Dominion Engineering Works Ltd., who spoke on "Pressure Feeding Iron Castings." The second speaker at this session was W. T. Shute, Canadian Car & Foundry Co. Ltd., Longue Point, Que., who presented a paper on "Pressure Feeding Steel Castings."

A. J. Moore, Montreal Bronze Ltd., Montreal, acted as chairman of the non-ferrous group. He introduced the two speakers, H. William Bennett, Dominion Engineering Works Ltd., and C. J. Converse, Crane Ltd., Montreal. Mr. Bennett spoke on "Gates and Risers," while Mr. Converse presented a paper on "Sand Control in the Bronze Foundry."

The third group meeting under the chairmanship of William Seeds, Western Pattern Works, Montreal, heard C. C. Brisbois, Robert Mitchell Co. Ltd., Montreal, talk on "Composition Matchplate Patterns."

Northeastern Ohio

Pat Dwyer
"The Foundry"
Chapter Reporter

OBSERVATIONS ON LIFE in the South Pacific and a practical discussion of centrifugal casting, were included in an interesting program presented to the February 14 meet-

ing of the Northeastern Ohio A.F.A. chapter, held at the Tudor Arms Hotel, Cleveland.

The theory, development, variations, and advantages and disadvantages of centrifugal casting, as well as the construction and operation of equipment, were discussed by Nathan Janco, Centrifugal Casting Machine Co., Tulsa, Okla. The speaker illustrated his remarks with slides showing typical castings, and with charts and formulas for calculating pouring speeds, machine speeds, and other aspects of the process.

Some interesting information on the Fiji Islands was reported by Richard McNelly, veteran of both World Wars. Mr. McNelly, recently discharged with the rank of Colonel, commanded the 637th Tank Destroyer Battalion in the South Pacific.

Birmingham District

J. P. McClendon
Stockham Pipe Fittings Co.
Chairman, Publicity Committee

ONE OF THE MOST interesting and enthusiastic conferences ever held by the Birmingham District chapter, climaxed with the Annual Banquet on Friday evening, February 15, was the Fourteenth Annual Foundry Practice Conference at the Tutwiler Hotel, Birmingham, Ala., February 14-16.

At the luncheon held Thursday, February 14, Chapter Vice-Chairman T. H. Benners, Jr., T. H. Benners & Co., introduced the A.F.A. National President, Fred J. Walls, International Nickel Co., Detroit. Mr. Walls explained that the foundry industry played a vital role in winning the war, and now will play an even more important role in the process of reconversion.

Pointing out that metal castings are necessary for the production of automobiles, refrigerators, machinery of all types and the construction of homes and buildings, President Walls said that the foundry industry was a basic sector of the economic system, without which our present type of civilization could not exist.

Mr. Walls said the war brought a great many developments to the industry, both in the revival of old techniques, made necessary by the requirements of certain articles of war, and in the development of new techniques, especially in the casting of magnesium and aluminum. Development of the latter, he stressed, enabled us to build the airplanes and high speed torpedo boats which contributed materially to the winning of the war.

Honorable W. Cooper Green, President, Birmingham City Commission, welcomed the delegates. A round of applause was accorded the large number of foundrymen from out of the city and state, who stood at Mr. Green's request.

Chapter Chairman J. A. Woody, American Cast Iron Pipe Co., Birmingham, expressed to Program Chairman J. A. Bowers, American Cast Iron Pipe Co., the appreciation of the chapter for the excellent conference program arrangements.

Technical Sessions Well Received

Delegates found the technical sessions interesting and informative. "Sand Properties and Their Relation to Casting Defects" was discussed by F. L. Overstreet, Illinois Clay Products Co., Joliet, Ill., Thursday morning, February 14; after which the speaker conducted a question and answer forum. Chapter Director J. F. Wakeland, Alabama Foundry Co., Birmingham, presided.

In the first Thursday afternoon session, with L. N. Shannon, Stockham Pipe Fittings Co., Birmingham, presiding, "The History and Development of the Foundry Industry" was the topic of Bruce L. Simpson, National Engineering Co., Chicago. Great interest was evinced by the conference in this discussion, in which Mr. Simpson traced the industry from its earliest beginnings in 2000 B.C. to the present.

Final address of the day was on "Variables in the Core Room—Their Treatment and Cure," by L. P. Robinson, Werner G. Smith Co., Cleveland. The speaker was introduced by Colonel J. E. Getzen, H. G. Mouat Associates, Birmingham, who presided.

Thursday evening's program was devoted wholly to entertainment under the direction of Chapter Entertainment Chairman Charles B. Saunders, Woodward Iron Co., Woodward, Ala. Technicolor motion pictures of the Alabama vs. Southern California Rose Bowl game were shown; and an entertaining floor show was presented.

Delegates Tour Local Plants

Visits to many local foundries and industries were undertaken Friday morning, February 15. Arrangements were in charge of Chapter Director J. F. Wakeland, Plant Visitation Chairman, who also provided transportation for the delegates.

Two technical sessions were held Friday afternoon. W. E. Jones, Stockham Pipe Fittings Co., presided at

Informal dinner gathering during the Birmingham Conference. Left to right: Chapter Secretary-Treasurer F. K. Brown, Adams, Rowe & Norman, Inc., Birmingham, Ala.; Chapter Chairman J. A. Woody, American Cast Iron Pipe Co., Birmingham; F. L. Overstreet, Illinois Clay Products Co., Joliet, Ill.; Registration Co-Chairman A. H. White, Stockham Pipe Fittings Co., Birmingham; Program Chairman J. A. Bowers, American Cast Iron Pipe Co.; E. Bremer, The Foundry, Cleveland; Entertainment Committee Chairman C. B. Saunders, Woodward Iron Co., Woodward, Ala.; E. C. Counselman, Illinois Clay Products Co.; W. E. Jones, Stockham Pipe Fittings Co.; Chapter Director J. T. Gilbert, Stockham Pipe Fittings Co.; Chapter Director J. F. Wakeland, Alabama Foundry Co., Birmingham; L. P. Robinson, Werner G. Smith Co., Cleveland.

an afternoon session, and introduced Thomas E. Barlow, Battelle Memorial Institute, Columbus, Ohio, whose subject was, "The Do's and Don'ts of Inoculation."

Final technical discussion of the conference took place Friday afternoon, with Dan B. Dimick, owner, Dimick Foundry, Birmingham, presiding. James A. Downey, Jr., Sloss Sheffield Steel & Iron Co., chose the subject, "You Must Have the Fourth 'E' in Foundry Safety." He pointed out that, in addition to the three "E's" of education, engineering and enforcement so important in a safety program, the oft-forgotten fourth "E" — enthusiasm — is necessary to make the program effective.

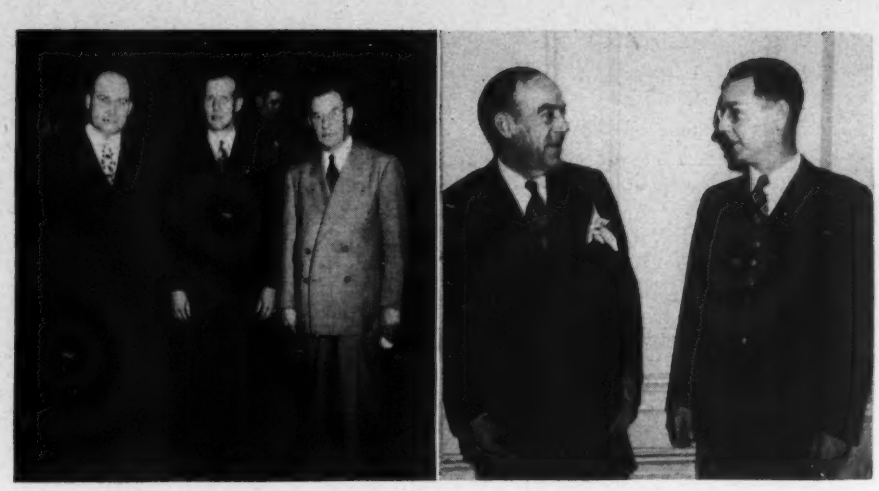
More than 450 delegates assembled at the Annual Banquet, Friday evening February 15, in the Terrace of the Tutwiler Hotel.

Introduced as Toastmaster by Chapter Chairman J. A. Woody was L. N. Shannon. The Chairman recalled that Mr. Shannon had served not only as the first and second chairman of the Birmingham chapter, but also as a National Director, Vice-President, and President of the A.F.A.

Mr. Shannon introduced the guest speaker of the evening, Milton H. Fies, consulting engineer, Birmingham, who discussed "Some Aspects of Research in the South."

How the South has awakened to the need for more industrial research was described by the speaker. As an instance, he referred to the Southern Research Institute which, with the sponsorship of southern industries and business men, is undertaking a $2,500,000 program.

Another tour of local facilities Saturday morning, February 16, concluded the conference program.



Left, a group from Alabama Clay Products Co., Birmingham, Ala., at the Birmingham Annual Foundry Conference; (left to right), H. W. Gethins, M. W. White and J. L. Cummings. Right, Membership Committee Chairman A. S. Holberg, Alabama Clay Products Co. (holding board) and Lloyd Stone, Stockham Pipe Fittings Co., Birmingham.

At the Birmingham Conference: Top (left to right), Chapter Chairman J. A. Woody, American Cast Iron Pipe Co., Birmingham, introducing former A.F.A. National Director, Vice-President and President L. N. Shannon, Stockham Pipe Fittings Co., Birmingham. Below (left to right), Chapter Director J. F. Wakeland, Alabama Foundry Co., Birmingham; F. L. Overstreet, Illinois Clay Products Co., Joliet, Ill.; and Program Chairman J. A. Bowers, American Cast Iron Pipe Co., Birmingham.

Northwestern Pennsylvania

E. M. Strick
Erie Malleable Iron Co.
Chapter Reporter

"MODERNIZATION IN FOUNDRIES" was the subject of an address by Lester B. Knight, Lester B. Knight & Associates, Inc., Chicago, given before eighty-five members of the Northwestern Pennsylvania chapter at the regular monthly meeting held January 28 at the Moose Club, Erie, Pa. Chapter Chairman Roger W. Griswold, Jr., The Griswold Mfg. Co., Erie, presided at the meeting and led the discussion period that followed.

Included in a number of out-of-town guests present at the meeting were: C. B. Schneible, Claude B. Schneible Co., Detroit, of the Detroit chapter; E. A. Hund, Lester B. Knight & Associates, Inc., of the Chicago chapter; Charles P. Hague, Claude B. Schneible Co., of the Western New York chapter; and

New members of the Birmingham District chapter at the Fourteenth Annual Foundry Conference in Birmingham, Ala.

Pei Chao, of Shanghai. The latter, a Chinese foundryman who recently received a Master's Degree from M.I.T., is visiting foundries throughout the United States before returning to China.

Completion of arrangements with the school district for the inauguration of a foundry course in a local high school, was announced by the chapter educational development committee, composed of Larry Dunn, General Electric Co., Erie, and John R. Metcalf, Erie Malleable Iron Co., Erie. This project is considered significant in its benefits to the foundry industry which is of major importance in the city's economic structure.

The committee also reported that a local foundry exhibit will be held in the local Y.M.C.A. two weeks after the 50th Anniversary Convention. This is being done to stimulate interest in the foundry industry among the local people.

Birmingham District

J. P. McClendon
Stockham Pipe Fittings Co.
Chairman, Publicity Committee

AN UNUSUAL PROGRAM, which allowed foundrymen an opportunity to obtain information of value to their businesses, was presented to 100 members and guests of the Birmingham District chapter, January 18, at the Tutwiler Hotel, Birmingham, when "Quiz Masters" answered all questions relating to the foundry industry.

Questions were freely asked and ably answered during the program, and the carefully selected experts in various phases of foundry practices clarified many points raised by those present.

Master of ceremonies for the quiz session was Morris Hawkins, Stockham Pipe Fittings Co., Birmingham.

The "Quiz Masters," selected by Chapter Program Chairman J. A. Bowers, American Cast Iron Pipe Co., Birmingham, and his committee, were: C. P. Caldwell, Caldwell Foundry & Machine Co., Inc.; H. H. Farr; J. T. Gilbert, Stockham Pipe Fittings Co.; R. A. Lloyd, Lee Bros. Foundry Co., Anniston, Ala.; Dr. J. T. MacKenzie, American Cast Iron Pipe Co.; W. O. McMahon, foundry consultant; W. M. Mobley, Alabama By-Products Corp.; and J. E. Reynolds, U. S. Pipe & Foundry Co.

Central Indiana

B. P. Mulcahy
Citizens Gas & Coke Utility
Chapter Historian

TIMELY DISCUSSION of "Wage Incentives in the Foundry," by C. E. Westover, Westover Engineers, Milwaukee, was presented to the February 4 meeting of the Central Indiana A.F.A. chapter.

Mr. Westover advocated the establishment of rates for each job in the foundry and incentive policies through which the workers profit by exceeding the established norm. The role of time and motion study was illustrated with a motion picture of the operations of a core maker before and after proper training in procedure.

Walter Wingenroth, National Malleable & Steel Castings Co., served as Technical Chairman, and directed the discussion period.

Metropolitan

C. J. Law
Worthington Pump & Machinery Corp.
Chapter Reporter

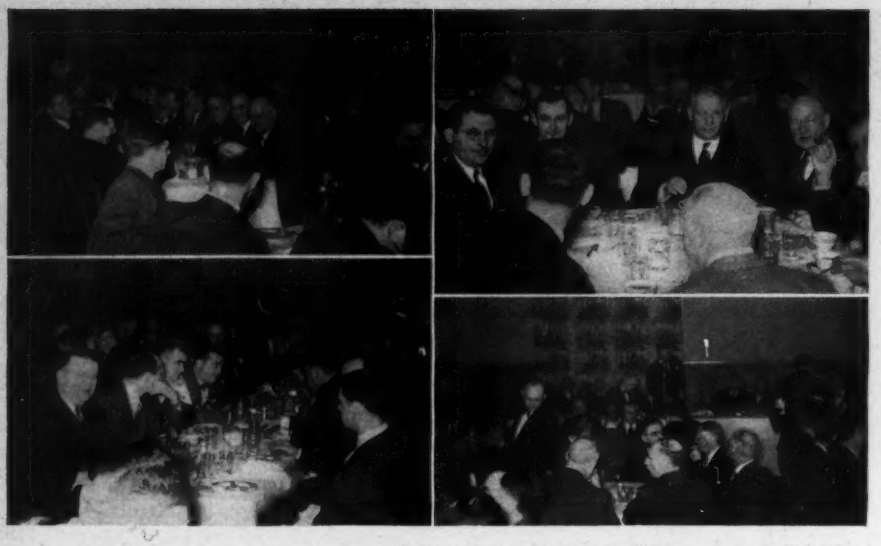
MEETING at the Essex House, Newark, N. J., February 4, the Metropolitan chapter devoted its evening to a round table discussion of melting practices. Approximately 90 members and guests were in attendance.

Chapter Chairman H. A. Deane, American Brake Shoe Co., New York, presided over the meeting and introduced the discussion leaders for each of the four sessions.

The steel group, under the leadership of Carl Jernstrom, Cooper Alloy Castings Co., Hillside, N. J., discussed the cause and elimination of pin holes in steel. It was agreed upon by the men at this session that

(Photos courtesy C. A. Wyatt, Debevoise-Andreson Co., Boston.)

The roving cameraman found these groups enjoying themselves at the 50th Anniversary celebration, New England Foundrymen's Association.



(Photos courtesy George F. Pettinos, Inc., Philadelphia.)

At the annual banquet of the Metropolitan chapter, December 7.

a metal boil must be obtained and that superheated metal tends to increase the formation of pin holes and lowers the fluidity.

John Bukowski, Worthington Pump & Machinery Co., Harrison, N. J., was the leader of the gray iron group which discussed cupola operation. Considerable interest was expressed by the group in bed lighting and contour patching of cupola linings. A lengthy discourse took place on air pressures and velocities of air through the cupola and its affect on melting and production.

W. Wilson, Eclipse-Pioneer Div., Bendix Aviation Corp., Brooklyn, N. Y., was the leader of the light metals group and presented information on fluxing, degassing and grain refining of aluminum and magnesium. Considerable interest was shown in the use of gases for degassing and grain refining of magnesium, such as the use of chlorine, carbon tetrachloride and others.

The discussion on copper base metals was led by William Decker, Bethlehem Steel Co., in a discussion on porosity in magnesium bronzes and other high zinc metals. Considerable time was devoted to explaining the substitution of nickel for tin in tin bronzes and the melting problems encountered in this change.

Western New York

L. A. Merryman
Tonawanda Iron Corp.
Chapter Secretary

RELATIONSHIP BETWEEN foundrymen and designing engineers was considered as one aspect of the subject, "Gray Iron Specifications," discussed by Thomas E. Barlow, foundry engineer, Battelle Memorial Institute, Columbus, Ohio, before the Western New York chapter, February 1, Hotel Touraine, Buffalo, N. Y.

Pointing out that specifications are drawn up by designing engineers rather than foundrymen, Mr. Barlow suggested that specifications—sometimes difficult if not impossible to follow—could best be simplified through the two groups working closely together.

Once the foundryman understands the properties of the metal he can produce, he will then be in a position to advise the engineer regarding selection of alloys to fit the design requirements, the speaker added.

Chapter Chairman Arthur H. Suckow, Symington-Gould Corp., Depew, N. Y., presided at the meeting.

C. E. Westover (standing beside projector), Westover Engineers, Milwaukee, discussing incentive policies before the February meeting of the Central Indiana chapter.

(Photo courtesy B. P. Mulcahy, Citizens Gas & Coke Utility.)

Northern California

Charles R. Marshal
Chamberlain Co.
Chapter Reporter

A PROGRAM DEVOTED entirely to patternmaking and problems involved in foundry-patternshop-customer relationships and procedures was presented to the A.F.A. Northern California chapter at its meeting January 11 in the Engineers Club, San Francisco.

George McDonald, pattern shop superintendent, H. C. Macaulay Foundry Co., Berkeley, was speaker of the evening, presenting an address, "Patterns and All Their Phases"; and Chapter Vice-President Richard Vosbrink, Berkeley Pattern Works, Berkeley, presided.

Program Chairman A. M. Ondreyco, Vulcan Foundry Co., Oakland, introduced the speaker. Mr. McDonald discussed four classifications of patterns; the one-off, the production, the in-between, and the permanent pattern.

He rounded out his subject with consideration of various foundry factors affecting patterns, such as: type of molding sand; modern molding machines, whose more intense jolt and squeeze action increase strains and wear on patterns; various types of flask equipment, demanding special pattern equipment; and core blowers, which present problems in the venting of cores and manufacture of dryers.

During the lively discussion which followed Mr. McDonald's remarks,

a number of points were brought out by the following patternmakers present: W. Beeman, Food Machinery Corp., San Jose; Fred Tomaseck, R. H. Raber Co., Los Angeles; R. G. Clement, United Pattern Works; Marvin Mento, Bay City Pattern Co.; R. L. Lambert, Production Pattern Shop; and LeRoy F. Kalin, A & L Pattern Works.

Contributing to the discussion, Leadingman Patternmaker Earl E. Greenwell gave a description of the pattern shop at the U. S. Navy Yard, Mare Island, which is possibly the largest on the coast as it occupies an entire floor and utilizes three additional floors for pattern storage.

Harris M. Donaldson, Brumley Donaldson Co., chapter Membership Committee Chairman, pointed out the values of membership in the A.F.A. to those present and urged them to continue to bring in new members.

Four new members were introduced: John E. Bacon, Wilson & George Meyer & Co.; Chester P. Sobey, Quarterman Molder, U. S. Navy Yard, Mare Island; W. R. Skinner, Jr., Vulcan Foundry Co.; and Earl E. Greenwell, Leadingman Patternmaker, U. S. Navy Yard, Mare Island. E. H. Brumley, Brumley Donaldson Co., was welcomed back into the chapter from his recent military duties.

Joseph L. Melling, H. C. Macaulay Foundry Co., instructor for the apprentice training course in molding, reported on work underway in this regard, and urged that management attract and make provision for more apprentices.

New England

T. R. Walker, Jr.
Warren Pipe Co. of Mass., Inc.
Association Reporter

THE SIXTH New England Regional Foundry Conference will be held at the Massachusetts Institute of Technology, Cambridge, Mass., March 29-30.

This conference is being sponsored jointly by the American Foundrymen's Association and the New England Foundrymen's Association. Other sponsors include: Massachusetts Institute of Technology; Boston chapter, Non-Ferrous Founders' Society; Connecticut Foundrymen's Association; and Connecticut Non-Ferrous Foundrymen's Association.

Aerial view of main educational building, Massachusetts Institute of Technology, where New England Regional Foundry Conference will be held.

Cooperating in the arrangements are: ASM, ASME, AIME, American Welding Society, and American Industrial Radium and X-Ray Society.

Conference Chairman is W. M. Saunders, Jr., Providence, R. I., a member of the Committee on Green Sand Properties, National A.F.A. Sand Research Project. Presiding at the initial technical session will be A.F.A. Gold Medalist and member of the Executive Committee, Gray Iron Division, R. F. Harrington, Hunt-Spiller Mfg. Corp., Boston.

"Melting of Bronze" will be discussed by W. B. George, R. Lavin & Sons, Inc., Chicago, Chairman of the National Sub-Committee on Yellow Brass, Brass and Bronze Division; while A.F.A. Gold Medalist D. J. Reese, International Nickel Co., New York, will speak on "Melting Cast Iron." C. B. Schureman, F. E. Schundler & Co., Joliet, Ill., who has been active in the National Sand Research Project, will address the conference on the subject of "Foundry Sands."

New England Regional Conference
March 29-30
Massachusetts Institute of Technology
Cambridge, Mass.

Friday, March 29

9:30 am—Opening Session

9:45 am—Welding
Speaker, V. T. Malcom, Chapman Valve Mfg. Co., Indian Orchard, Mass.
"Repair Welding of Castings"

10:45 am—Cleaning
Speaker, Fred Mosely, Whitehead Bros. Co., New York.
"Cleaning of Castings"

11:30 am—Inspection
Speaker, Dr. J. T. Norton, Massachusetts Institute of Technology.
"Radiographic Inspection of Castings"

12:15 pm—Luncheon

2 pm—Lumen S. Brown Lecture
Speaker, G. H. Reama, American Screw Co., Providence, R. I.
"Can We Continue the System of Free Enterprise?"

2:45 pm—Mechanization
Speaker, L. B. Knight, Lester B. Knight & Associates, Chicago.
"Mechanization of the Modern Foundry"

4 pm—Non-Ferrous
Speaker, W. B. George, R. Lavin & Sons, Chicago.
"Melting of Bronze"

6 pm—Conference Dinner
Speaker, Dr. K. T. Compton, Massachusetts Institute of Technology.
"War-time Activities of M.I.T."
Speaker, F. G. Steinbach, Editor, *The Foundry*, Cleveland.
"Progress in Castings"

Saturday, March 30

9:30 am—Sand
Speaker, C. B. Schureman, F. E. Schundler & Co., Joliet, Ill.
"Foundry Sands"

10:45 am—Cast Iron
Speaker, D. J. Reese, International Nickel Co., New York.
"Melting Cast Iron"

12 noon—Luncheon

2 pm—Defects
Speaker, George Johnstone, Cooper-Bessemer Corp., Grove City, Pa.
"Casting Defects"

3:30 pm—Gating and Risering
Speaker, H. F. Taylor, Naval Research Laboratory, Washington, D. C.

ABSTRACTS

NOTE: The following references to articles dealing with the many phases of the foundry industry, have been prepared by the staff of *American Foundryman*, from current technical and trade publications.

When copies of the complete articles are desired, photostat copies may be obtained from the Engineering Societies Library, 29 W. 39th St., New York, N. Y.

Aluminum-Base Alloys

FLUXING. Hulme, P. M., *"Fluxing Molten Aluminum with Dry Nitrogen,"* MATERIALS AND METHODS, November, 1945, vol. 22, no. 5, pp. 1435-1438.

Nitrogen can be used to flux aluminum-base alloys as efficiently as chlorine and more economically. Nitrogen is introduced into the melt in the same manner as chlorine is introduced.

Brass and Bronze

POROSITY. George, William B., *"Porosity in Navy G and M Metals,"* THE IRON AGE, November 15, 1945, vol. 156, no. 20, pp. 68-70.

A discussion of the porosity due to foundry practice in a cylindrical casting. Although the discussion refers to a specific casting, the porosity is of a type encountered in other castings.

Chemical Analysis

ANALYSIS. Kobe, Kenneth A., and Mason, George E., *"Aqueous Solutions of Alcohols as Confining Liquids for Gas Analysis,"* INDUSTRIAL AND ENGINEERING CHEMISTRY, Analytical Edition, January, 1946, vol. 18, no. 1, p. 78.

The use of polyhydric alcohols for collecting gas samples is described, and their efficiency compared with solutions of inorganic salts. Aqueous solutions of alcohols are more convenient than mercury and are advantageous because of low freezing point.

EVALUATION. Churchill, H. V., *"A System of Laboratory Evaluation,"* INDUSTRIAL AND ENGINEERING CHEMISTRY, Analytical Edition, January, 1946, vol. 18, no. 1, p. 66.

A system is described for evaluating laboratories which does not require complicated evaluation of statistics. The method obviates the use of standard samples eliminating possibility of recognition and special treatment by analysts. In use 20 years, the checking system reveals the quality of work done in laboratories making the same type of analyses.

NICKEL. Haim, G., and Tarrant, B., *"Colorimetric Determination of Nickel in Bronzes,"* INDUSTRIAL AND ENGINEERING CHEMISTRY, Analytical Edition, January, 1946, vol. 18, no. 1, p. 51.

Avoiding electro-deposition or sulfide precipitation, the method employs hypophosphite precipitation and filtration to remove copper. Nickel is determined colorimetrically using dimethylglyoxime. The method has been successful on bronzes containing up to 17.5 per cent nickel. A single determination requires about 30 minutes.

Conveyors

MOLD. (*See Materials Handling.*)

Inspection

METHODS. Rigbey, James V., *"Correlation of Inspection Methods in the Metal Industry,"* CANADIAN METALS AND METALLURGICAL INDUSTRIES, November, 1945, vol. 8, no. 11, pp. 36-40.

The author discusses older methods of inspection; non-destructive testing; gamma-ray radiography; the significance of radiography; and methods used to supplement radiography.

Light Metal Alloys

FLUXING. (See *Aluminum-Base Alloys.*)

Materials Handling

SAND AND MOLDS. Lamenzo, Maj. J. B., *"Foundries of the Future,"* THE FOUNDRY, December, 1945, vol. 73, no. 12, pp. 88-93, 258, 260, 262.

The author discusses improvements in sand and mold handling equipment which will make possible improved working conditions and greater operating economy in the foundry.

Molding Materials

SILICA FLOUR. Shaw, Harold, *"Substitutes for Silica Flour in the Foundry,"* FOUNDRY TRADE JOURNAL, Oct. 18, 1945, vol. 77, no. 1522, pp. 143-144.

Since the silicosis hazard makes it likely that silica flour will gradually cease to be used, manufacturers have looked for suitable substitute materials. They have found four materials—chamotte, zirconium silicate, molachite, olivine. Of these, zirconium silicate has proved to be the most satisfactory, especially for use with steel castings of heavy section.

Porosity

NAVY G AND M. (See *Brass and Bronze.*)

Refractories

SILICA BRICKS. Howie, T. W., *"Spalling of Silica Bricks,"* THE REFRACTORIES JOURNAL, December, 1945, no. 12, 21st year, pp. 471-481.

The author describes laboratory tests to study the low temperature spalling of silica bricks and gives the conclusions drawn from test results.

His tests indicated that the amount of spalling is a function of heating rate. Faster heating caused cracks to form nearer the surface. For hard-fired silica brick, from 5-6° C. per minute was the maximum safe heating rate. Soft-fired bricks permitted a more rapid heating rate.

Wet bricks spalled more quickly than dry bricks when heated on only one face, but showed superior spalling resistance when heated from all sides. Spalling resistance was also increased by soaking in creosote.

It was found that the degree of spalling was largely dependent on temperature gradients within the brick.

ZIRCON. Thielke, N. R., and Jamieson, H. W., *"Development of Zircon as a Versatile Ceramic Material,"* BULLETIN OF THE AMERICAN CERAMIC SOCIETY, December 15, 1945, vol. 24, no. 12, pp. 452-456.

"A survey is presented of the development and applications of zircon in modern ceramics. The distribution, mineral occurrences, and commercial deposits are described, and mining and beneficiation methods are outlined. The physical and chemical properties of various commercial zircon products especially interesting to the ceramic engineer are tabulated, with particular reference to the application of zircon in the fields of refractories, enamels, glazes, and special porcelains."

Salvage

DEFECT REMOVAL. Blake, A. E. Jr., *"Flame-Gouging of Steel Castings,"* MATERIALS AND METHODS, November, 1945, vol. 22, no. 5, pp. 1428-1431.

Flame-gouging of steel castings can be used in place of chipping to remove defects in almost any ferrous structure up to 0.40 per cent carbon. The method and types of defects which can be removed are described.

Steel

HEAT TREATMENT. Eddy, C. T., Marcotte, R. J., and Smith, R. J., *"Time-Temperature Transformation Curves for Use in the Heat-Treatment of Cast Steel,"* METALS TECHNOLOGY, Sept., 1945, vol. 12, no. 6, 18 pp.

A report of an investigation to determine the S-curves for certain cast steels; whether the published S-curves for wrought steels were satisfactory for use with cast steels of the same composition and to prepare hardenability curves for the selected cast steels.

Results of the investigation indicated the S-curves for wrought steels could be used in the heat treatment of steel castings. Differences in the positions of the S-curves caused by structural differences were small in comparison to those caused by variation in composition.

The hardenabilities of cast steels compared favorably with those of wrought steels.

The S-curves and hardenability curves determined are presented in the article. Tabular matter includes the analyses, treatment, properties, and critical temperatures of the steels tested.

Welding

FLAME-GOUGING. (See *Salvage.*)

X-ray

INSPECTION. Goodman, David, *"Continuous X-ray Inspection,"* CANADIAN METALS AND METALLURGICAL INDUSTRIES, Nov., 1945, vol. 8, no. 11, pp. 32-35, 52.

A description of a 2,000 kv. p. x-ray unit and the accessory equipment used to expedite x-ray inspection at the Elwood ordnance plant.

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Abrasive Cut-off Machine

Buehler, Ltd., Chicago, announce a 1 hp. abrasive cut-off machine. This cutter is a table mounted model and is capable of cutting 1-in. stock metal samples. Coolant is supplied by a recirculating tank which is placed on the floor with hose connections to cutter.

Crucible Furnace

Radiant Combustion, Inc., Warren, Ohio, has announced a top fired crucible melting furnace, using two crucibles (fired with gas or oil) in tandem. Furnace holds two crucibles, loaded at all times and alternately fired. Covers are cam lifted and swung backward independent of one another. Faster heating is claimed through combined radiant and convection heating.

Tandem crucible furnace showing lids being removed from heated crucibles.

Two-Stage Heating Controller

The Bristol Co., Waterbury, Conn., has adapted a standard model of microact controller to the special requirement of two-stage firing of gas furnaces. An extra switch is used and the temperature at which the transfer from low temperature firing to high temperature firing is set by adjusting the extra switch.

First Aid Kit

Medical Supply Co., 75 West Van Buren St., Chicago, has announced a first aid kit for factory and foundry

(Continued on Page 97)

NEW PRODUCTS

(Continued from Page 90)

use. Contains packages of dressings and medication for ordinary emergencies or surgical dressings for more serious injuries. Kit can be bracketed to the wall, carried by convenient carrying handle or placed on first aid shelf in locker.

Grinding Wheels

Bay State Abrasive Products Co., Westboro, Mass., has a diamond vitrified grinding wheel for the grinding of cemented carbide tools and other super-hard substances.

Diamond vitrified grinding wheels and hand hones.

Pyrometer

Pyrometer Instrument Co., New York, has developed an immersion pyrometer that has a 4¾-in. indicator with a 4-in. direct reading scale calibrated to 1500° F. and 2500° F. Features interchangeable bare metal and protected type thermocouples. Designed with a shielded steel housing to eliminate demagnitization of the movements, is dust-proof, moisture-proof and shock-proof.

Quantometer

Harry W. Dietert Co., Detroit, and *Applied Research Laboratories*, Glendale, Calif., have designed and built a direct-reading instrument which allows the quantitative chemical analysis of as many as eleven elements in metal alloys, chemicals, and a wide variety of other materials in less than one minute.

Quantitative spectro-chemical analysis is the specific purpose of this instrument, hence its name, the Quantometer. Principal advantage of the machine is the great speed with which it can simultaneously and automatically measure the quantities of a number of elements present in a sample. These results appear directly as percentage composition on a series of counters, one for each element being determined. Only one operator is necessary.

Operator tabulating the quantitative chemical analysis of an alloy.

Automatic Flow Regulator

Waterman Engineering Co., Chicago, is now producing an automatic regulator for hydraulic systems. Available in all pipe sizes, the regu-

(Continued on Page 99)

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St. Louis, Mo.	Midwest Foundry Supply Co.
San Francisco, Calif.	Industrial Supply Co.
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(Continued from Page 97)

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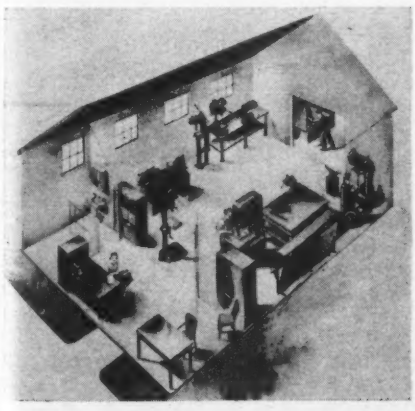
Machine Shop

The DoAll Co., Des Plaines, Ill., has constructed eight model service and repair shops planned by their industrial engineers to assist G.I.'s who want to go into business for themselves; these streamlined machine shops can be housed in a variety of places.



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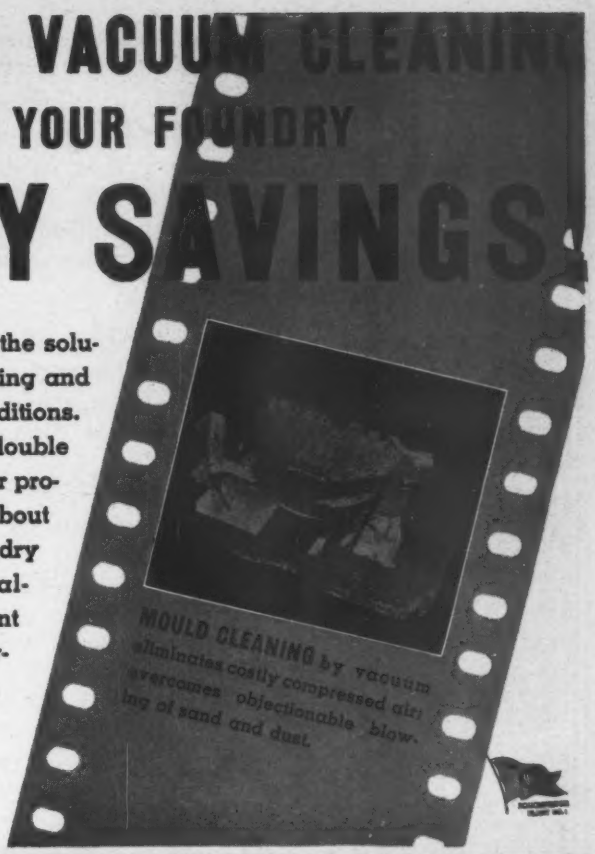

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4. Pictures, charts and diagrams. 5. Discussions which took place when the papers were presented.

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NEW LITERATURE

"Hercules Chemist," No. 15, has been published by Hercules Powder Co., Wilmington 99, Del., and is available upon request from the above concern.

A descriptive circular and data sheet on a constant flow regulator for hydraulic systems can now be obtained from Waterman Engineering, 721 Custer Ave., Evanston, Ill.

Carpenter Bros. Inc., 606 W. Wisconsin Ave., Milwaukee 3, is publishing "Foundry Notes." Anyone wishing to obtain copies or be placed on the mailing list to obtain copies should write to the above address.

A new aluminum alloy produced by The National Smelting Co., 6700 Grant Ave., Cleveland, is described in their bulletin "Allcast Aluminum Alloy." Copies may be obtained from the above concern.

An improved overhead conveyor trolley is described in Folder No. 2041 published by Link-Belt Co., Chicago. Copies can be obtained from the above concern.

A quick-reference slide rule giving 98 different melting points for tin-lead solder alloys is being offered free to those who request it from Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5.

"Your Unseen Friend," a booklet published by International Nickel Co., Inc., 67 Wall St., New York 5, illustrating their advertising and promotional activities, is now available upon request.

Westlectric Castings, Inc., 2040 So. Camfield Ave., East Los Angeles, has published a brochure illustrating various foundry operations and procedures in the manufacture of steel castings. Copies may be obtained upon request.

The Lead Industries Association, 420 Lexington Ave., New York, has printed a chart graphically depicting the principal mining districts in the United States where lead is produced, smelted and refined, and how

(Continued on Page 101)

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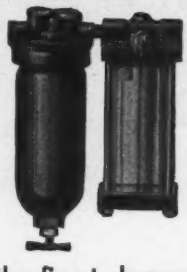

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NEW LITERATURE

(Continued from Page 100)

it is generally used by industry. Copies may be obtained free.

Better Finishes and Coatings, Inc., Newark, N. J., has published a booklet showing interesting applications of a peelable plastic film.

M-B Products, Detroit 26, has published a number of bulletins concerning their pneumatic grinders, air line filters and automatic air line lubricators. These bulletins are available upon request.

Pittsburgh Metals Purifying Co., 1352 Marvista St., Pittsburgh, Pa., has published a small leaflet describing their carbon-free liquidizer.

The Bristol Co., Waterbury, Conn., has published Bulletin No. PB1228 which describes a two-stage heating controller.

Grede Foundries, Inc., Milwaukee, recently published a brochure in connection with the celebration of their twenty-fifth year in the foundry industry.

American Foundry Equipment Co., Mishawaka, Ind., has recently published catalog No. 214 which gives complete information about the new wheelabrator swing table.

A booklet entitled "Bearing Alloys Technical Manual" is now available for distribution. It is issued free by Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5, and presents information to assist engineers and consumers of bearing alloys in the design, construction and maintenance of friction-type bearings for all machinery.

A bulletin, No. 6885, describing "Flexlastics" has been issued by Raybestos-Manhattan, Inc., Manhattan Rubber Div., Passaic, N. J.

Operations of Caterpillar equipment in various phases of industry are shown in full color in Issue 92 of Caterpillar Magazine, the first all-color issue of the publication. Mine, highway, oilfield, farm and forest are shown in vivid, natural tones as the background against which the company's units perform.

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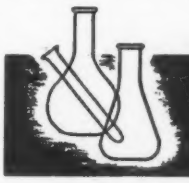

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